A SERVICE ORIENTED CROP PROFITABILITY SIMULATOR [CPS] REALIZING WITH WEB SERVICES

by

REZA NABI

Bachelor of Engineering, Department of Computer Science and Engineering,
Zhejiang University, Hangzhou, PR China 1996

A THESIS

submitted in partial fulfillment of the requirements for the degree

MASTER OF SOFTWARE ENGINEERING

Department of Computing and Information Sciences
College of Engineering

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2010

Approved by:

Major Professor
Dr. Daniel Andresen

Abstract

The Service Oriented Architecture (SOA), a bleeding-edge architectural paradigm, facilitates software development by providing modular design, scalability, robustness, loosely coupled application integration, and software reuse. With the XML, SOAP, WSDL, and UDDI open standards, the Service Oriented Architecture (SOA) allows interoperability between widely disparate applications running on different platforms and implemented in different languages.

The Department of Agriculture has a legacy Crop Profitability Simulator (CPS) which is an Excel spreadsheet that allows farmers in Kansas and surrounding states to assess market risks by viewing income, cost, and profit, based on the Kansas Farm Management guides. Due to the limitations of Excel, the CPS software has various shortcomings with regards to robustness, scalability, interoperability, usability, and reuse.

This thesis examines the shortcomings of the legacy system and improves upon the CPS Software to build an architectural infrastructure by using SOA realizing with de-facto standard web services. To demonstrate the benefits of SOA, we developed two CPS Clients (CPS Web application and CPS iPhone application), implemented in different languages and deployed on different platforms. The CPS Web application developed using C# language on Microsoft's .NET platform deployed on Windows and the CPS iPhone application developed using Objectiv-C language on Apple's Coacoa platform running the iPhone OS. Both CPS clients communicate with a central relational database, MS SQL Server 2008 via web services, using the same server components (Business Logic Layer Component and Data Access Layer Component) to ensure the highest level of modularity, maintainability, and software reuse.

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Acknowledgements

Before I express my special thanks and gratitude to individuals, I bear witness that all praise is due to my Lord, who created me and to Him I shall return, for His countless blessings and mercy upon me and my family.

I am heartily thankful to Dr. Daniel Andresen, as my Major Professor, and Dr. Hikaru Peterson, as my committee member, for giving me a chance to work on this wonderful project, building service oriented software realizing with web services. Without their guidance, encouragement, and support from inception, I could not have finished this project. I am also grateful to Dr. Neilsen, for feedback during the life-cycle of the project and kindly agreeing to be on my committee.

My deepest gratitude goes to my family for their love and support; I could not have come this far without them. Looking back on the last 6 years, I know I have spent many weekends researching without spending quality time with my beautiful wife, Roxy, my daughter Samah, and my son Tahsin. Indeed, they are so patient and supportive of me. I would like to extend my special thanks to my 9-year old daughter Samah, and 6 year old Son Tahsin, for helping Daddy create the Table of Contents. I am eternally grateful to Ammu, Daddy, and Mommy, for their love, support, and constant prayers for me.

I would like to thank my manager Alan Uhl for being kind, supportive, and approving vacations on very short notice to work on my thesis. I am truly indebted to Rosanne Haines, Sage HR Manager, for serving as my Proctor for the past 6 years. I would like to extend my deepest regard and appreciation to Amit Borcar and Suresh Pothuri for being my formal technical inspectors, and spending their valuable time on this project. I would also like to thank Sophia Lyimo and Elizabeth Dobelstein, QA Analysts, for their best wishes and willingness to test my work.

Lastly, I offer my thanks to all of my friends for being supportive and letting me study, or work on this project, during various social gatherings.

CHAPTER 1 - VISION DOCUMENT

1 Introduction

Kansas State University currently uses a legacy product that enables farmers in Kansas and surrounding states to assess market risks based on the Kansas Farm Management guides. The current product does not allow the user to compare multiple plans simultaneously, view a profit summary, or take in to account variations in yield, price, and cost. This project addresses the shortcomings of the legacy application and builds an architectural infrastructure suitable for expandability by using Service Oriented Architecture (SOA) realizing with de-facto standard web services.

1.1 Motivation

Department of Agriculture has a legacy Crop Profitability Simulator (CPS) which is an Excel spreadsheet that allows farmers in Kansas and surrounding states to assess market risks by viewing income, cost, and profit, based on the Kansas Farm Management guides. The major shortcomings of the legacy system include:

- It provides default Cost and Income values along with breakdown based on Kansas Management Guides but it does not provide a profit summary.
- It does not facilitate comparing multiple plans simultaneously. Since farmers need to assess market risks, it would be useful to provide a view of multiple plans side-by-side, and display high-end, low-end, and average profit summaries.
- It does not take in account variation in entities such as yield, price, and cost.
- Due to the limitations of Excel, the application has various shortcomings with regards to robustness, scalability, interoperability, usability, reuse, and the power of a relational database.

The motivation of this project is not only to address the shortcomings of the legacy application but to build an architectural infrastructure suitable for decades to come by using Service Oriented Architecture (SOA) realizing with de-facto standard web services.

The SOA, a bleeding-edge architectural paradigm, facilitates software development by providing modular design, scalability, robustness, loosely coupled application integration, and software reuse. With the open standards like XML, SOAP, WSDL and UDDI, the Service Oriented Architecture (SOA) allows interoperability between widely disparate applications running on different platforms and implemented in different languages.

To demonstrate the benefits of SOA, we developed two CPS Clients (CPS Web application and CPS iPhone application), implemented in different languages and deployed on different platforms. The CPS Web application was developed using C# language on Microsoft's .NET platform and deployed on Windows, and the CPS iPhone application was developed using Objective-C language on Apple's Coacoa platform running on the iPhone OS. Both CPS clients communicate with a central relational database, MS SQL Server 2008, via web services using same server components (Business Logic Layer Component and Data Access Layer Component) to ensure the highest level of modularity, maintainability, and software reuse.

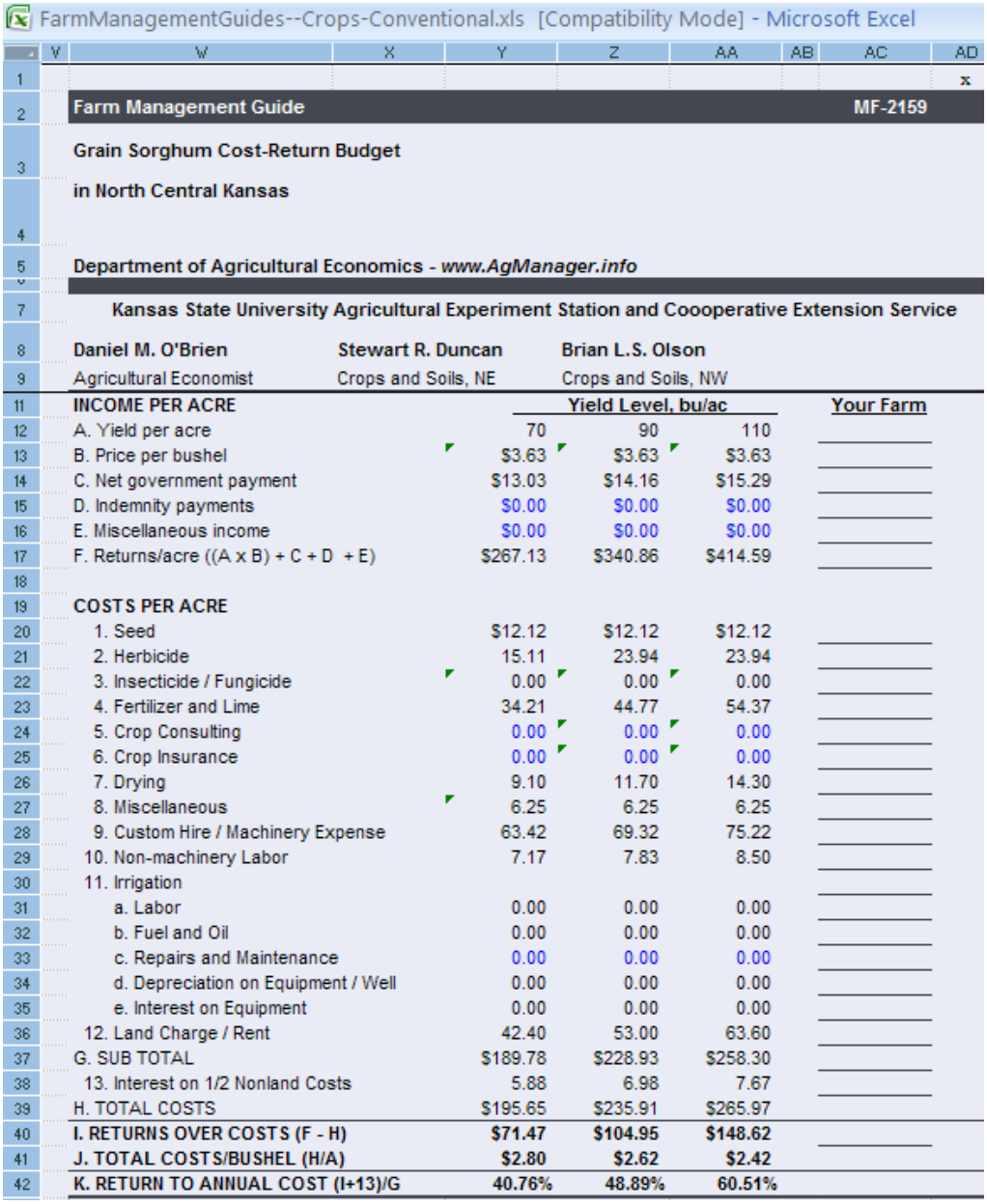
1.2 Terms and Definitions

- **Plan –** Combination of picking i) a crop (e.g. corn, wheat), ii) crop system (e.g. organic, conventional), iii), land type (e.g. dry, irrigated), and iv) area of total land in acreage \
- **Expected Variation** – The quantity in percent, cost and income value may vary. This gives high-end and low-end profitability in addition to the average.
- **Return Over Cost** – This is same as profit. It is measured as per acre.
- **CPS** – Crop Profitability Simulator, the product we are building to help farmers assess market risks for multiple plans by comparing profitability side by side.
- **SOA** – Service Oriented Architecture, an architectural paradigm used to promote modular design, scalability, robustness, loosely coupled application integration, interoperation, and software reuse.

1.3 Crop Profitability Simulator (CPS)

The legacy CPS system is an Excel spreadsheet where users may view default Income and Cost values of a crop for a given region based on Kansas Farm Management Guides. Below is the screenshot of legacy CPS System.

Figure 1.1.1 CPS Legacy app provides default income and cost value



FarmManagementGuides--Crops-Conventional.xls [Compatibility Mode] - Microsoft Excel

Farm Management Guide MF-2159

Grain Sorghum Cost-Return Budget

in North Central Kansas

Department of Agricultural Economics - ***www.AgManager.info***

Kansas State University Agricultural Experiment Station and Coooperative Extension Service

Daniel M. O'Brien	**Stewart R. Duncan**	**Brian L.S. Olson**
Agricultural Economist	Crops and Soils, NE	Crops and Soils, NW

INCOME PER ACRE	**Yield Level, bu/ac**			**Your Farm**
A. Yield per acre	70	90	110	
B. Price per bushel	$3.63	$3.63	$3.63	
C. Net government payment	$13.03	$14.16	$15.29	
D. Indemnity payments	$0.00	$0.00	$0.00	
E. Miscellaneous income	$0.00	$0.00	$0.00	
F. Returns/acre ((A x B) + C + D + E)	$267.13	$340.86	$414.59	
COSTS PER ACRE				
1. Seed	$12.12	$12.12	$12.12	
2. Herbicide	15.11	23.94	23.94	
3. Insecticide / Fungicide	0.00	0.00	0.00	
4. Fertilizer and Lime	34.21	44.77	54.37	
5. Crop Consulting	0.00	0.00	0.00	
6. Crop Insurance	0.00	0.00	0.00	
7. Drying	9.10	11.70	14.30	
8. Miscellaneous	6.25	6.25	6.25	
9. Custom Hire / Machinery Expense	63.42	69.32	75.22	
10. Non-machinery Labor	7.17	7.83	8.50	
11. Irrigation				
a. Labor	0.00	0.00	0.00	
b. Fuel and Oil	0.00	0.00	0.00	
c. Repairs and Maintenance	0.00	0.00	0.00	
d. Depreciation on Equipment / Well	0.00	0.00	0.00	
e. Interest on Equipment	0.00	0.00	0.00	
12. Land Charge / Rent	42.40	53.00	63.60	
G. SUB TOTAL	$189.78	$228.93	$258.30	
13. Interest on 1/2 Nonland Costs	5.88	6.98	7.67	
H. TOTAL COSTS	$195.65	$235.91	$265.97	
I. RETURNS OVER COSTS (F - H)	**$71.47**	**$104.95**	**$148.62**	
J. TOTAL COSTS/BUSHEL (H/A)	**$2.80**	**$2.62**	**$2.42**	
K. RETURN TO ANNUAL COST (I+13)/G	**40.76%**	**48.89%**	**60.51%**	

2 Project Overview

The proposed software, The Whole Farm CPS, allows farmers in Kansas and surrounding states to assess market risks for multiple farming plans, including conventional and organic farming methods. The goal of this project is to improve upon the legacy system and implement new features to facilitate scalability, robustness, integration, and improved usability. The Whole

Farm CPS shall be accessible on two operating environments; a website accessible through common web browsers as well as an application accessible from an iPhone or iPod Touch.

2.1 Product Perspective

The proposed software, The Whole Farm CPS, allows farmers in Kansas and surrounding states to assess market risks for multiple farming plans, including conventional and organic farming methods.

In addition to the default values based on Kansas Farm Management Guides, the Simulator enables the user to customize calculations to individual situations in terms of specific revenue and cost items and possible variability in price, yield, and cost. The whole farm profitability for multiple plans will be summarized in a graph for easy comparison. Detailed feature is available in section 3 of Chapter 1 (Vision Document).

2.2 Project Goal

In addition to addressing the shortcomings of legacy system stated in section 1.1 of Chapter 1, the proposed software, CPS, will be built on top of Service Oriented Architecture (SOA) realizing with Web Services

The SOA facilitates software development by providing modular design, scalability, robustness, loosely coupled application integration, and software reuse. With open standards like XML, SOAP, WSDL and UDDI, the Service Oriented Architecture (SOA) allows interoperability between widely disparate applications running on different platforms and implemented in different languages.

To demonstrate the benefits of SOA, we will develop two CPS Clients (**CPS Web application** and **CPS iPhone application**), implemented in different languages and deployed in different platforms. The CPS Web application was developed using C# language on Microsoft's .NET platform deployed on Windows and the CPS iPhone application was developed using Objective-C language on Apple's Coacoa platform running on the iPhone OS. Both CPS clients communicate with a central relational database, MS SQL Server 2008, via web services using the same server components (Business Logic Layer Component and

Data Access Layer Component) to ensure highest level of modularity, maintainability, and software reuse.

CPS Web Application. A fully functional web application will be developed to allow farmers to calculate return over costs based on their personalized data, such as expenses and income. The web application will be accessible live at http://home.nabi.us/CpsWeb/. The detailed requirements of the web application are available in section 3.1 of Chapter 1.

CPS iPhone Applicaton. The Crop Profit Simulator with at least 2 plans (so that they can be compared by user) will be developed to run on the iPhone and the iPodTouch. The light-weidght CPS iPhone application will assist us to demonstrate benefits of SOA having two disparate systems using the same server components. The detailed requirements of the iPhone application are available in section 3.2 of Chapter 1.

2.3 Operating Environment

There are two major operating environments required for the product, CPS.

- The web services and web application will be deployed on Windows 2008 server running .NET framework 3.5 or higher. IIS will be used on the http server. MS SQL Server 2008 will be used for the back-end database. The website can be viewed through common Internet browsers.
- The iPhone CPS application will be running on IPod Touch (or iPhone) OS 3.0 or higher. An internet connection will be required to run the CPS application as the client will be communicating with backend server via web services.

2.4 Design and Implementation Constraint

The AJAX-enabled web application will be built using the Microsoft .NET framework and C# (C Sharp) will be used to develop the product. The iPhone application, will be built using Cocoa framework, and Objective-C will be used to develop the product. Both web and iPhone application will be built on SOA and both clients will communicate with the same server components via web services. The SOA will facilitate a modular design, scalability, robustness, loosely coupled application integration and interoperation, and software reuse.

2.5 User Documentation

A user manual will be provided for both the CPS web application and the iPhone application. The user may contact the developer of this product or Dr. Andresen regarding any ambiguity in the documentation.

3 Project Requirement

The Whole Farm CPS product will have the following features (requirements) stated in section 3.1 (**Web application**) and section 3.2 (**iPhone application**).

3.1 Features of CPS Web Application

3.1.1 Home (Main Home Page)

The product will have a hyper link called ‘Home’ which will be displayed when the user accesses the CPS application URL at http://home.nabi.us/CpsWeb/. Content of the main home page includes short description of the Whole Farm CPS product, how to access the simulator, frequently asked questions, and hyperlinks to major sponsors of this project.

3.1.2 FAQ

The product will have a hyperlink for frequently asked questions, 'FAQ', with answers and screenshots where applicable. The information in the FAQ section will help users understand the product, its uses, and troubleshoot issues without contacting support.

3.1.3 Contact Us

The product will have a hyperlink called ‘Contact us’, which will provide the user with the contact information of resources for general questions or comments. The information of the contact page includes name, email, phone number, and physical address.

3.1.4 About CPS

The product will have a hyper link called ‘About CPS’ which will display the name of the product, version, build date, and copyright information.

3.1.5 Simulator

The product will have a hyper link called ‘Simulator’ which will bring up the main Crop Profitability Simulator application. The CPS application has the following features available.

3.1.5.1 Plan

A user is able to specify up to 4 plans with different combinations of crop, acreage, land type, and crop system.

3.1.5.2 Crops

There should be no limitation on how many crops a user may choose. The list of crops will be based on the data stored in the database. For each crop, the user should be able to view default costs and income values. The application should also enable the user to enter their personalized values for cost and income. The calculation of profit (return over cost) should be entirely based on what the user has entered in the “Cost” and “Income” fields.

3.1.5.3 Summary

When observing or modifying a plan, a summary table will be displayed and updated automatically. The information in Summary table will include crop, acre, cost, income, and profit for each crop. At the bottom of the summary table, “Farm per Acre” and “Farm Total” will be displayed for the given plan.

3.1.5.4 Expected Variation

For each plan, there will be an “Expected Variation” table where the user can enter “Yield”, “Cost” and “Price” that can vary at the user’s farm. The expected variation data shows the user the best, worst, and average estimates of the profit.

3.1.5.5 Summary Details

The summary, along with its breakdown, will be available for each plan in the “Summary Details” tab. The whole farm profitability (return over cost) for multiple plans will also be summarized in a graph for easy comparison with best/worst estimates when an expected variation value is entered.

3.1.5.6 User Interface

The User Interface is dynamic, clean, and suitable for the target audience – mildly technical farmers exploring their options.

3.2 Features of CPS iPhone Application

3.2.1 Simulator

To demonstrate the benefit of SOA, a mini version of the CPS iPhone application will be developed with the following features.

3.2.1.1 Plan

Users should be able to specify at least 2 plans with different combinations of crop, acreages, land type and crop system.

3.2.1.2 Crops

There are no limitations placed on how many crops a user can choose. The list of crops will be based on the data available in the database and should be identical to the web client's Crop drop down list. With the iPhone version of the simulator, personalized cost and income value will not be entertained.

3.2.1.3 Expected Variation

For each plan, there will be an "Expected Variation" table where the user can enter "Yield", "Cost" and "Price" that can vary at the user's farm. The expected variation data shows the user the best, worst, and average estimates of the profit.

3.2.1.4 Summary

There will be a summary tab in iPhone version of simulator. In this tab, a summary table along with expected variation and « High », « Mean » and « Low » values will be displayed. A break down of costs and income is not provided.

3.2.1.5 User Interface

The user interface has been developed as per Apple's UI guidelines.

4 Non-Functional Requirements

4.1 Performance Requirement

Performance may vary depending on the hardware used to host the application. However, maintaining a response time of less than 7 seconds for any page is expected.

4.2 Safety Requirement

If deployed at KSU Campus, the KSU IT team shall be responsible for the daily backup of the data. If deployed on the developer's LAN, the developer shall be responsible for the daily backup.

4.3 Security Requirement

The product must be physically located behind a firewall with a private IP so that the system is not publicly accessible. Only port 80 will be open to access the CPS web application and CPS web services.

4.4 Software Quality Attribute

Service Oriented Architecture, MVC design pattern along with an object oriented programming approach should be used while developing this product, which will help to boost the metrics when it comes to flexibility, reusability, maintainability, scalability, and interoperability.

5 Other Requirements

None

CHAPTER 2 - PROJECT PLAN

1 Overview

This project plan document provides a task break down, completion criteria of tasks, and cost estimation of the project using COCOMO model. As per the MSE portfolio guide line, the project is broken down into three major phases. After each phase, certain artifacts (refer to section 2) need to be produced, followed by a presentation to the committee.

2 Task Breakdown

2.1 Inception Phase

The inception phase will concentrate on the project's overview and requirements. This phase will include the production of a Vision Document 1.0, a Project Plan 1.0, a Software Quality Assurance Plan 1.0, and a simple prototype of the software.

2.1.1 Vision Document

This document will include the project's critical requirements. It gives a listing of features / requirements and labels each requirement as functional and non-functional, or Future. Requirements include validation rules and should be associated with unique section ids so that each requirement can be easily traceable. The introduction to this project includes its goals and motivation of the proposed product.

2.1.2 Project Plan

This document will include a timeline for the project and a cost estimate for completing this project. Cost estimates will be developed using the COCOMO estimating methodology. All activities involved with this project will be associated with milestones outlined within this document according to the modern software process. This process includes: Inception Phase, Elaboration Phase, Production Phase, and the Transition Phase.

2.1.3 Software Quality Assurance Plan

This document will include an outline of required documents. To ensure software quality, practiced standards and conventions will be monitored and followed. This document will outline project reviews and the responsibilities of those associated with the proposed software, Crop Profitability Simulator (CPS).

2.1.4 Simple Prototype

A simple prototype will be developed to demonstrate at least one aspect of the software. It will demonstrate some of the critical requirements outlined in the Vision Document, such as implementation of critical validation rules. This is completed to demonstrate feasibility or to illuminate risky project requirements.

Completion Criteria: The phase will be complete once supervisory committee has approved 2.1.1 to 2.1.4.

2.2 Elaboration Phase

The elaboration phase will concentrate on the project's architecture. This phase will include the production of an Architectural Design document, revisions to the Project Plan and the Vision Document, a formal specification, Test Plan, and two architecture inspections.

2.2.1 Architectural Design Document

The Architecture Design plan will include appropriate UML diagrams such as class diagrams, use-case diagrams, and sequence diagrams as per the IEEE Std. 1471-2000, IEEE recommended practice for Architectural Description.

2.2.2 Revision of Project Plan and Vision Document

Appropriate changes will be made to project plan 1.0 and vision 1.0 document as per the recommendation of the committee.

2.2.3 Formal Specification

CPS software will be formally specified using core UML and OCL. The USE model along with testing scripts to hold specified constraint and to violate constraint will

be produced. A transcript document holding results of all test script along with explanation (if needed) will also be produced.

2.2.4 Test Plan 1.0

The test plan will include a complete testing procedure for the project. This will include all test suites required to test all the functional requirements and appropriate procedures for reporting and correcting failed test.

2.2.5 Architecture Inspection

Two professional Software Engineers will perform formal technical inspections and send their report to major Professor, Dr. Andresen.

2.2.6 Demo the Prototype

Most of the functional requirements should be demonstrated end of the elaboration phase. If there is any architectural challenge is encountered and failed to demo most of the functional requirements, committee must be notified at least a week before the 2nd presentation.

Completion Criteria: The phase will be complete once supervisory committee has approved 2.2.1 to 2.1.6.

2.3 Production Phase

The production phase will include project implementation and testing. This phase includes project coding and documentation.

2.3.1 Project Coding and Testing

Project coding will consist of all committee approved and designated tasks to be coded and developed. Testing will be done while coding and Test plan 1.0 document will be revised and updated with appropriate changes.

2.3.2 Project Documentation

A complete User Manual document of the CPS software will be produced. In addition to the final report of the project, Component Design document and project evaluation document will also be produced.

2.3.3 Demo the CPS Software, the release candidate

All functional features outlined in the vision document in section 3.1 and 3.2 should be demonstrated.

Completion Criteria: The phase will be complete once supervisory committee has approved 2.3.1 to 2.3.3.

3 Cost Estimate

3.1 COCOMO

The COnstructive COst MOdel (COCOMO) developed by Barry Boehm will be used to estimate project effort and time. There are three modes, based on software domains, to estimate project effort and time in COCOMO. These modes are organic, semidetached, and embedded. Organic mode projects are less complex developments and have fair flexibility. Embedded mode projects are usually similar to defense projects. Complexity, reliability, and real-time issues play a bigger role in embedded mode projects. Semidetached mode projects represent a hybrid between organic and embedded mode projects. The CPS Software based on SOA with Web and iPhone client have average complexity and fair flexibility. Thus, I would consider CPS in an organic mode project. COCOMO cost estimation for organic mode projects follow the following formula:

Effort = 3.2*EAF*(Size) ^1.05

Time = 2.5*(Effort) ^0.38

Where:

Effort = number of staff months

EAF = Effort Adjustment Factor

Size = number of lines of code for completed product. It is measured in KLOC

Time = total number of months

The Effort Adjustment Factor is the product of the 15 adjustment parameters. Each adjustment parameter is defined as very low, low, nominal, high, or very high. The table 1 below shows all the adjustment factors and their ranges.

Table 2.3.1 COCOMO EAF Parameters

Identifier	Effort Adjustment Factor	Range
RELY	Required reliability	0.75 - 1.40
DATA	Database size	0.94 – 1.16
CPLX	Product complexity	0.70 – 1.65
TIME	Execution time constraint	1.00 – 1.66
STOR	Main storage constraint	1.00 – 1.56
VIRT	Virtual machine volatility	0.87 – 1.30
TURN	Computer turnaround time	0.87 – 1.15
ACAP	Analyst capability	1.46 – 0.71
AEXP	Applications experience	1.29 – 0.82
PCAP	Programmer capability	1.42 – 0.70
VEXP	Virtual machine experience	1.21 – 0.90
LEXP	Language experience	1.14 – 0.95
MODP	Use of modern practices	1.24 – 0.82
TOOL	Use of software tools	1.24 – 0.83
SCED	Required development schedule	1.23 – 1.10

Table 2.3.2 Adjusted EAF Values applied to CPS Project

Identifier	Level / Reasoning	My Value
RELY	Low – Project is not safety critical	0.76

DATA	Low – Current size of the database is low. But i twill grow in future	0.98
CPLX	Moderate – Complexity of the product is medium	1.1
TIME	Moderate – Project need to respond to client (The Committee)	1.15
STOR	Low – No store constraint	1.0
VIRT	Moderate - Complexity of the software and hardware is moderate	0.95
TURN	Very Low – Results are reported to the developer very quickly	0.88
ACAP	High – Developer is experienced in analysis and design	1.3
AEXP	High – Developer is experienced in project oriented application development.	1.1
PCAP	High – Developer has enough programming experience.	1.2
VEXP	Moderate – Developer has moderate experience with other project components, excluding software.	1.1
LEXP	Moderate – Developer is experienced in C# (used to develop web application / web service) but does not have good experience in Objective C, used for iPhone develoment.	1.0
MODP	High – Project uses modern practices	1.0
TOOL	Moderate – Use of tool is moderate. Developer preferes to write code by hand instead of tools.	0.92
SCED	Moderate – Project is tightly schedule ; allowing time is permissible with Supervisor's approval.	1.1

The EAF value is calculated to 1.5. Based on the source code of the CPS prototypes of both web and iPhone applications, I estimated the size to be **5500 LOC** (*Web: 2500 LOC + iPhone : 2000 LOC*).

Effort = 3.2*1.5*(5.5) ^1.05 = 28.74 staff months

Time = 2.5*(15.2) ^0.38 = 8.9 months (the development time)

I think that 28.74 staff months for Effort is accurate for a project like CPS where we will be building simulator for both the web and iPhone, using web services. A project like this has no non-value added items and turnaround time between developer and client (The

Advisor) is prompt. Since this project has a staff of a single developer with access to the necessary resources, non-development overhead is minimal.

Thus, in my opinion, for an MSE project like the CPS, a realistic Effort value should be between 5 to 6 staff-months. With the adjusted value of staff-months (5.5), the new development time can be calculated as:

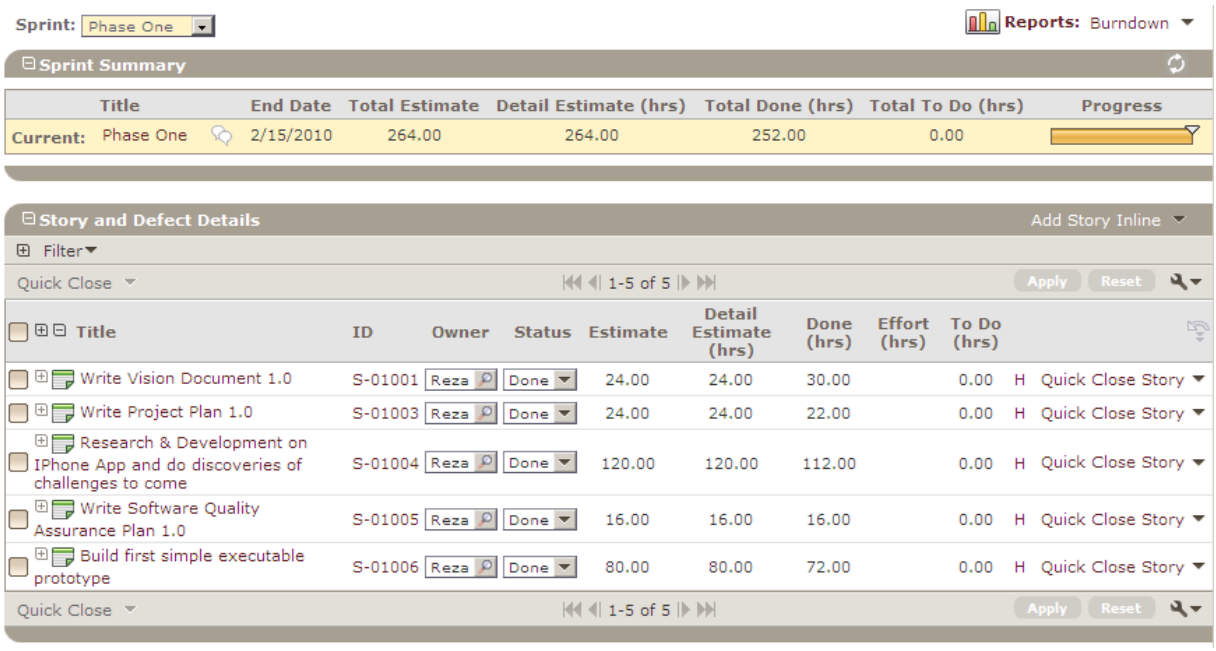
Time = 2.5*(5.5) ^0.38 **= 4.7 months**

4 Sprint Planning

The development of this Project is divided into three sprints. Each sprint is dedicated to do the development for each phase discussed in section 2 (Task breakdown). In this section, we will display action items for each sprint. The software VersionOne is used to track all the action items throughout the project.

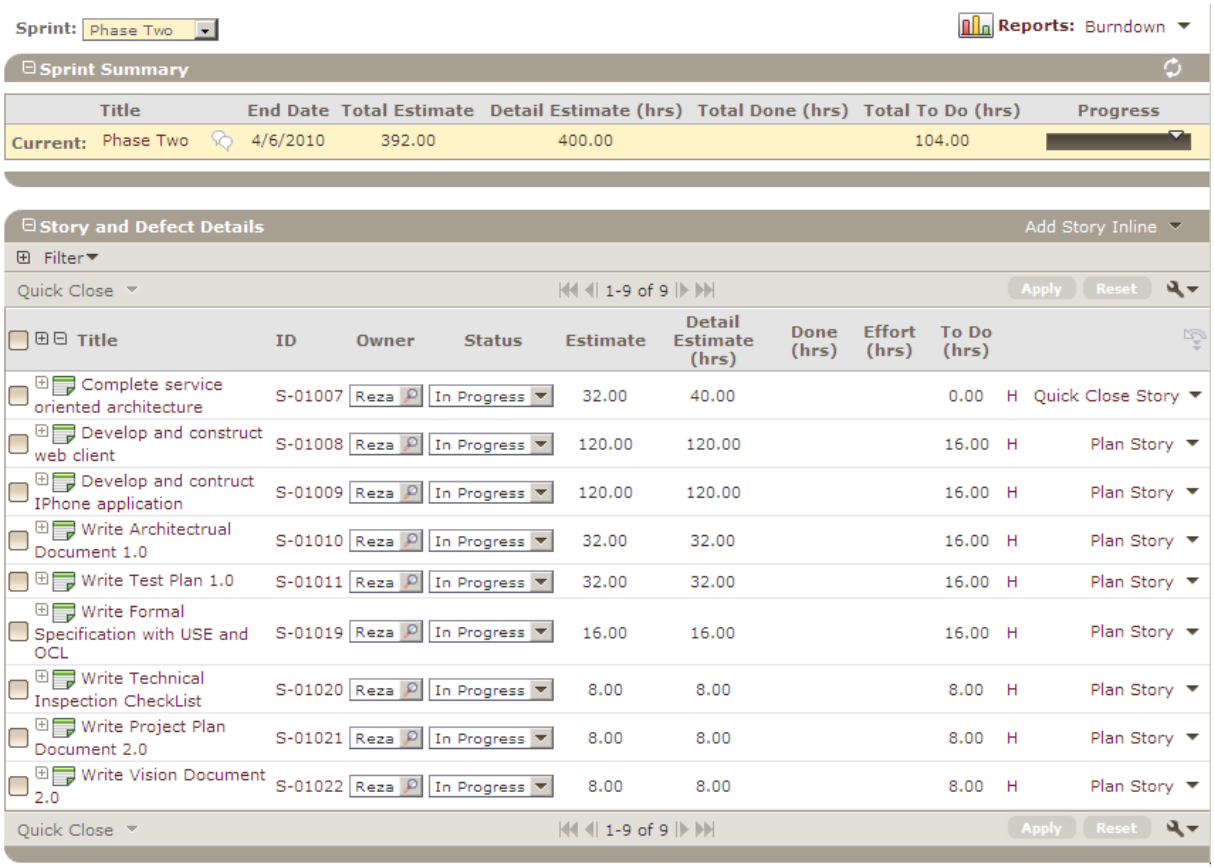
4.1 Phase One (Inception) Sprint Plan

Figure 2.4.1 Action Items of Phase One Sprint


Sprint: Phase One
Reports: Burndown
Sprint Summary
Title End Date Total Estimate Detail Estimate (hrs) Total Done (hrs) Total To Do (hrs) Progress
Current: Phase One 2/15/2010 264.00 264.00 252.00 0.00
Story and Defect Details
Add Story Inline
Filter
Quick Close
1-5 of 5
Apply
Reset
Title ID Owner Status Estimate Detail Estimate (hrs) Done (hrs) Effort (hrs) To Do (hrs)
Write Vision Document 1.0 S-01001 Reza Done 24.00 24.00 30.00 0.00 H Quick Close Story
Write Project Plan 1.0 S-01003 Reza Done 24.00 24.00 22.00 0.00 H Quick Close Story
Research & Development on IPhone App and do discoveries of challenges to come S-01004 Reza Done 120.00 120.00 112.00 0.00 H Quick Close Story
Write Software Quality Assurance Plan 1.0 S-01005 Reza Done 16.00 16.00 16.00 0.00 H Quick Close Story
Build first simple executable prototype S-01006 Reza Done 80.00 80.00 72.00 0.00 H Quick Close Story
Quick Close
1-5 of 5
Apply
Reset

4.2 Phase Two (Elaboration) Sprint Plan

Figure 2.4.1 Action Items of Phase Two Sprint



Sprint: Phase Two — Reports: Burndown

Sprint Summary

Title	End Date	Total Estimate	Detail Estimate (hrs)	Total Done (hrs)	Total To Do (hrs)	Progress
Current: Phase Two	4/6/2010	392.00	400.00		104.00	

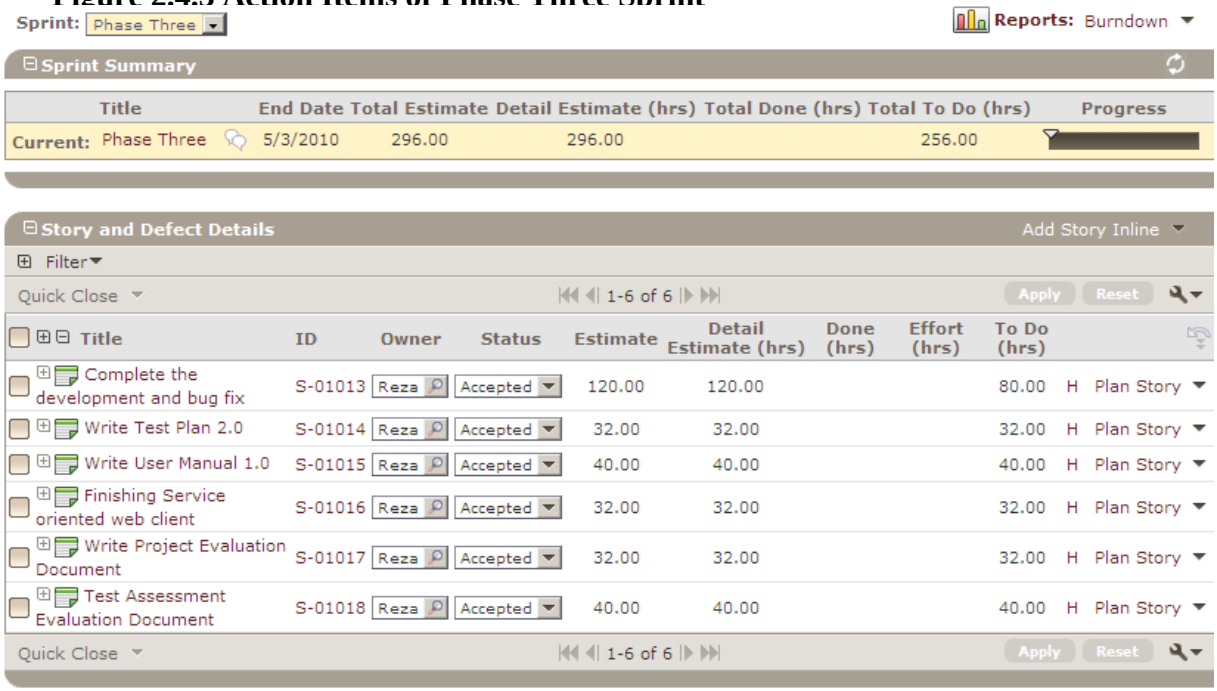
Story and Defect Details — Add Story Inline — Filter — Quick Close — 1-9 of 9 — Apply — Reset

Title	ID	Owner	Status	Estimate	Detail Estimate (hrs)	Done (hrs)	Effort (hrs)	To Do (hrs)		
Complete service oriented architecture	S-01007	Reza	In Progress	32.00	40.00			0.00	H	Quick Close Story
Develop and construct web client	S-01008	Reza	In Progress	120.00	120.00			16.00	H	Plan Story
Develop and contruct IPhone application	S-01009	Reza	In Progress	120.00	120.00			16.00	H	Plan Story
Write Architectrual Document 1.0	S-01010	Reza	In Progress	32.00	32.00			16.00	H	Plan Story
Write Test Plan 1.0	S-01011	Reza	In Progress	32.00	32.00			16.00	H	Plan Story
Write Formal Specification with USE and OCL	S-01019	Reza	In Progress	16.00	16.00			16.00	H	Plan Story
Write Technical Inspection CheckList	S-01020	Reza	In Progress	8.00	8.00			8.00	H	Plan Story
Write Project Plan Document 2.0	S-01021	Reza	In Progress	8.00	8.00			8.00	H	Plan Story
Write Vision Document 2.0	S-01022	Reza	In Progress	8.00	8.00			8.00	H	Plan Story

Quick Close — 1-9 of 9 — Apply — Reset

4.3 Phase Three (Production) Sprint Plan

Figure 2.4.3 Action Items of Phase Three Sprint



Sprint: Phase Three — Reports: Burndown

Sprint Summary

Title	End Date	Total Estimate	Detail Estimate (hrs)	Total Done (hrs)	Total To Do (hrs)	Progress
Current: Phase Three	5/3/2010	296.00	296.00		256.00	

Story and Defect Details — Add Story Inline — Filter — Quick Close — 1-6 of 6 — Apply — Reset

Title	ID	Owner	Status	Estimate	Detail Estimate (hrs)	Done (hrs)	Effort (hrs)	To Do (hrs)		
Complete the development and bug fix	S-01013	Reza	Accepted	120.00	120.00			80.00	H	Plan Story
Write Test Plan 2.0	S-01014	Reza	Accepted	32.00	32.00			32.00	H	Plan Story
Write User Manual 1.0	S-01015	Reza	Accepted	40.00	40.00			40.00	H	Plan Story
Finishing Service oriented web client	S-01016	Reza	Accepted	32.00	32.00			32.00	H	Plan Story
Write Project Evaluation Document	S-01017	Reza	Accepted	32.00	32.00			32.00	H	Plan Story
Test Assessment Evaluation Document	S-01018	Reza	Accepted	40.00	40.00			40.00	H	Plan Story

Quick Close — 1-6 of 6 — Apply — Reset

CHAPTER 3 - ARCHITECTURE DESIGN

1 Overview

The overview provides the purpose, scope, and intended user of the proposed software, the Crop Profitability Simulator (CPS), the useful terms and definition and references used during production of this document.

1.1 Purpose

The purpose of this document is to outline architectural design of the CPS software. This architectural document should help to lay foundation for quality of the software and cost gain through standardization of elements and practices using UML diagrams and notations for architectural description.

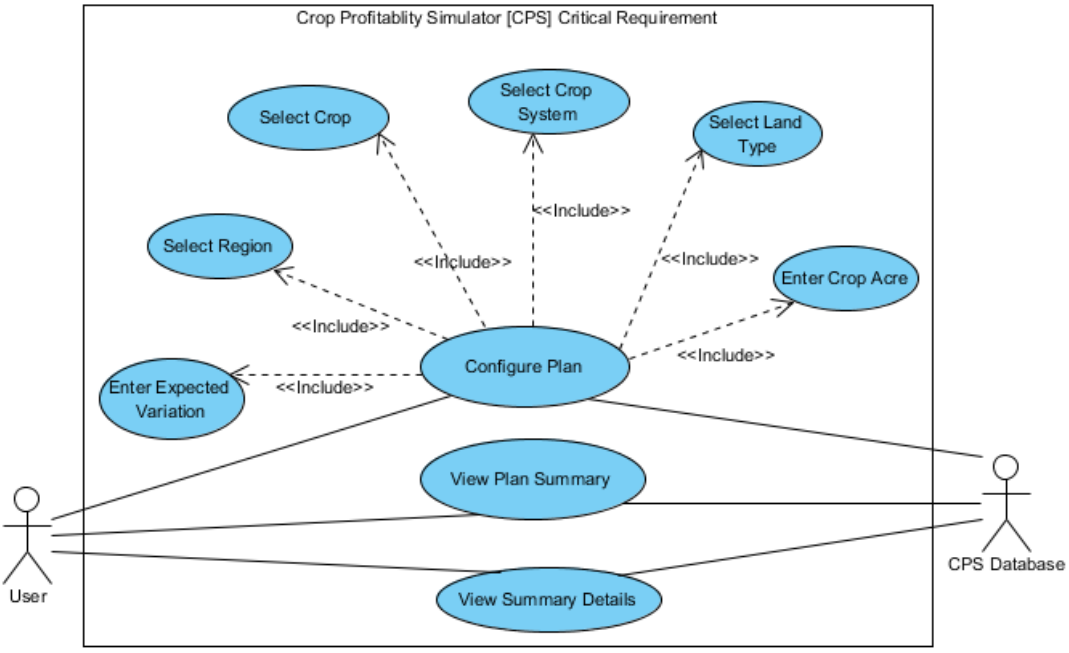
1.2 Terms and Definitions

- **Plan** – Combination of picking i) a crop (e.g. corn, wheat), ii) crop system (e.g. organic, conventional), iii) land type (e.g. dry, irrigated) and iv) area of total land in Acre that may apply to a farmer's local farm.
- **Expected Variation** – The quantity in percent Cost and Income value may vary. This gives high-end and low-end profit in addition to average.
- **Return Over Cost** – This is same as profit. It is measured as per Acre.
- **View** – A representation of a whole system from the perspective of a related set of concerns.

1.3 Scope

The proposed software, CPS, is used by farmers to assess market risks by comparing profits summary side-by-side for multiple plans. The configuring plans include selecting region, crop, crop system (e.g. organic, conventional), land type and total acres. The following is the use case of a base CPS system. For details of the requirement, please refer to Vision document, Chapter 1.

Figure 3.1.1 Critical Use Case Diagram of CPS software



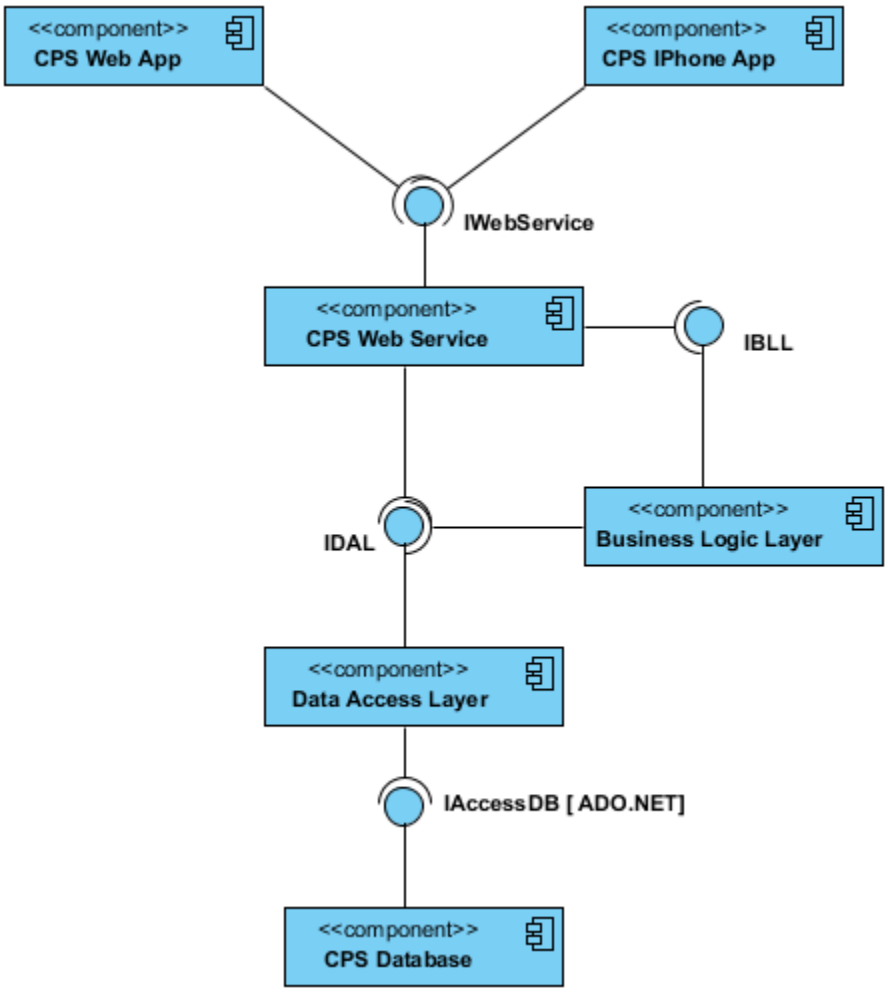
2 Architecture of the System

The CPS software is built on top of Service Oriented Architecture (SOA) realizing with web services to facilitate loosely coupled application integration among various platforms and software reuse. In this project, two clients (CPS iPhone app and CPS Web app) running different platform have been developed and both clients share the same Business Logic Layer (BLL) components, Data Access Layer (DAL) components and the same backend database. Refer to Component Diagram in section 2.1 and deployment diagram in section 2.2 for details of software reuse and loosely coupled application integration.

2.1 Component View

This section provides component diagram of the CPS software followed by class diagram of each component.

Figure 3.2.1 Component Diagram of CPS Software



Description: Both CPS iPhone app and CPS Web app component communicates with CPS Web service component to get access to Data Access Layer (DAL) directly or via Business Logic Layer (BLL) component (e.g. calculate and return data for CPS Analysis) to get data from CPS database.

Note: This Architecture regardless to what client needs are: iPhone or web it use the same BLL, DAL and CPS Database component.

2.1.1 CPS Web Client Component

The design pattern MVC (Model-View-Controller) is followed building CPS web app/client component. This component consists of ASP.NET web form (View) and its

code-behind class (Controller) that communicates with CPS database (Model) via CPS Web service.

Table 3.2.1 List of View and Controller of CPS Web App

Web Forms and its Controller	Purpose
Default.aspx [View] Default.aspx.cs [Controller]	To render main home page.
AboutCPS.aspx [View] AboutCPS.apsx.cs [Controller]	Render 'About CPS' page
ContactUs.aspx [View] ContactUs.aspx.cs [Controller]	Render 'Contact Us' page
Faq.aspx [View] Faq.aspx.cs [Controller]	Render 'Faq' page
Simulator.aspx [View] Simulator.aspx.cs [Controller]	Launch 'CPS', the main application

2.1.2 CPS iPhone Client Component

Like CPS Web app/client component, the design pattern MVC (Model-View-Controller) is also strictly followed building CPS iPhone app/client component to facilitate clean separation and enforce code/software reuse. This component consists of NIB files (View) along with its Controller class which communicates with CPS database (Model) via CPS Web service component. In addition to view and controller, some other helper classes are also added to this component to process results rendered by web service, sharing information among the tabs (plan1, plan2, summary). Below are the entities of the CPS iPhone app/client component.

Table 3.2.2 List of View and Controller of CPS iPhone App Component

NIB File and its Controller	Purpose
MainWindow.xib [View] CPSAppDelegate.m [Controller]	Render the main form of the application. This is where the CPS iPhone application launches.

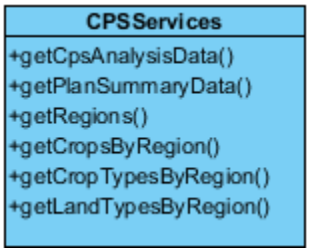
	This holds and manages the entire UI elements for the application.
PlanOneView.xib [View] PlanOneViewController.m [Controller]	Render plan configuration UI where user selects crop, crop system, land type, acre, and expected variation etc. for Plan One.
PlanTwoView.xib [View] PlanTwoViewController.m [Controller]	Render plan configuration UI where user selects crop, crop system, land type, acre, and expected variation etc. for Plan Two.
SummaryView.xib [View] SummaryViewController.m [Controller]	Render UI for Summary tab.
RegionTableView.xib [View] RegionTableController.m [Controller]	Render the UI where user picks a region first before configuring the plan one.
RegionTwoTableView.xib [View] RegionTwoTableController.m [Controller]	Render the UI where user picks a region first before configuring the Plan Two

Table 3.2.3 Helper Classes used in CPS iPhone App Component

Class files	Purpose
WebServiceHelper.m	Help to initiate and configure web service connection properties.
XMLDataSetParser.m	Help to parse and process the XML data, response from the web service.
DataSet.m	Custom data structure to hold the parsed data done by XMLDataSetParser class. This helper class also helps to find records/data with ease.
DdlCropSystem.m DdlLandType.m DdlCrop.m	These classes help to gives user a drop down experience in iPhone application instead of UIView picker. This is to save real-estate in configuring plan UI.
AppData.m	This class is designed using singleton pattern. This helps to share data among tabs.

2.1.3 CPS Web Service Component

Figure 3.2.2 Class diagram of CPS Web Service Component



CPSServices class is the heart of SOA. This class implements all the required web methods to facilitate clients (Web app or iPhone app) to have access to BLL (Business Logic Layer) and DAL (Data Access Layer) components and return the results to the caller (client). Below are the lists of web methods along with descriptions.

Table 3.2.4 - Web Methods for CPSServices class

Web Method Name	Description
getCpsAnalysisData()	This helps to return the calculated data which is used to display profit (high, low, mean) for each plan side-by-side. This method uses CpsAlanysis class from BLL component to serve the request made by the client.
getPlanSummaryData()	This helps to return the calculated summary data for each plan in the plan configuration screen. This method uses Plan Summary class from BLL component to do the task.
getRegions()	This helps to return the list of regions available in the CPS database.
getCropsByRegions()	This helps to return the list of crops available for a given region.
getCropTypesRegions()	This helps to return the list of CropTypes available for a given region.
getLandTypesRegions()	This helps to return the list of Land Types available for a given region.

2.1.4 Business Logic Layer (BLL) Component

This section provides class diagrams and brief description of classes used in BLL component.

Figure 3.2.3 Class diagram of BLL Component

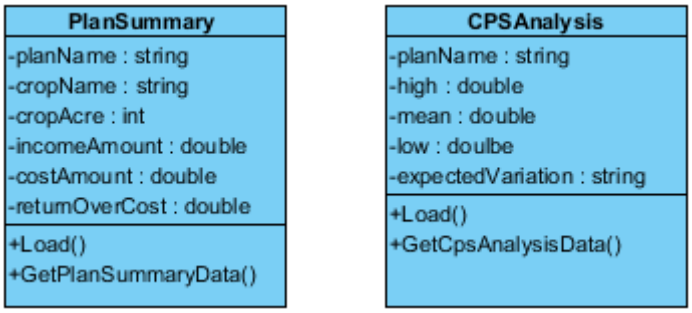


Table 3.2.4 Classes of BLL Component

Class Name	Description
PlanSummary	This user defined data structure helps to represent plan summary data displayed with user configure a plan. In this project, this BLL class is used by web client only. The method GetPlanSummaryData() is used to return dataset to display complete plan summary.
CPSAnalysisData	This helps to represent CPSAnalysis data which is used to display overall return over costs with High, Low, Mean value (if expected variation entered) for multiple plans side-by-side.

2.1.5 Data Access Layer (DAL) Component

This section provides class diagrams and brief description of classes which is used in DAL component that is responsible to communicate with CPS Database component (the physical database) via ADO.NET framework.

Figure 3.2.4 Class diagram of DAL Component

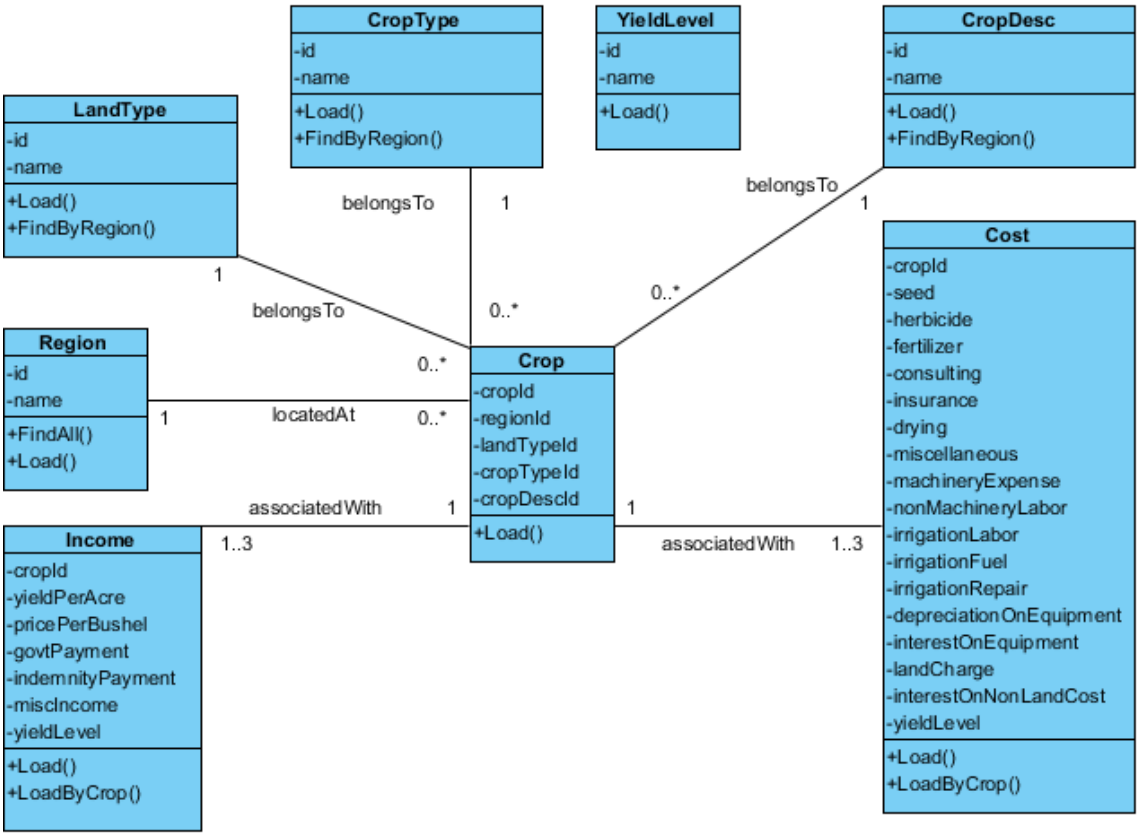


Table 3.2.5 Classes of DAL Component

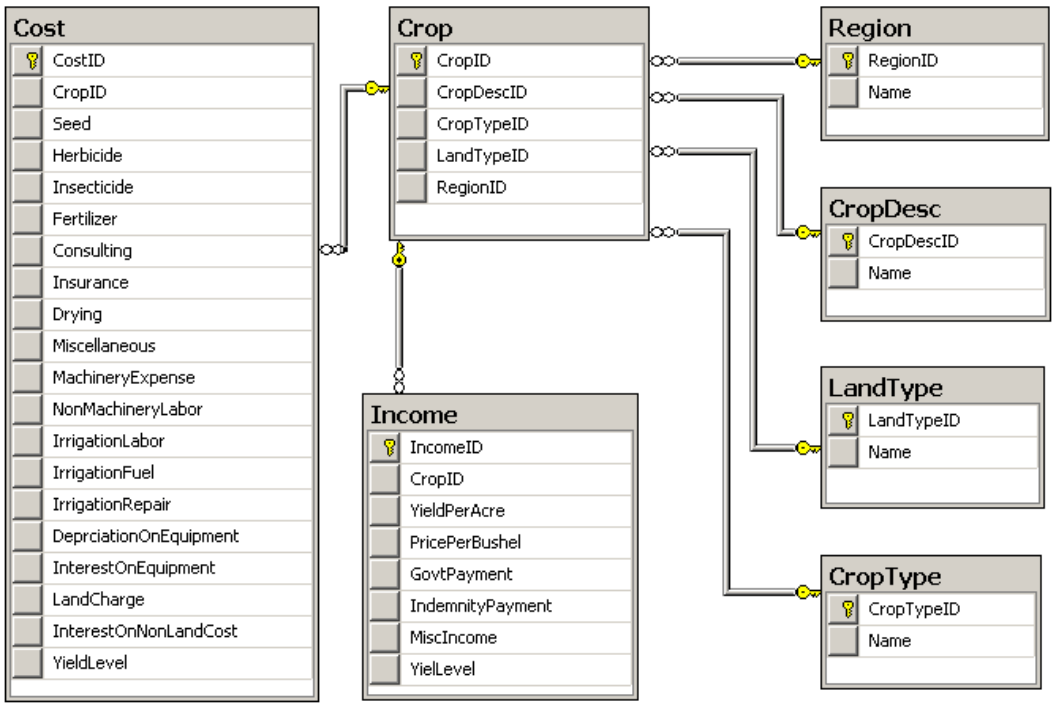
Class Name	Description
Region	This class represents location of the land (e.g. North West, South West etc.) and responsible to make operation to physical data table ‘Region’. This class is used to list the locations (region) of crop in both clients.
LandType	This class represents type of the land (e.g. Dry, Irrigated etc) and responsible to make operation to physical data table ‘LandType’. This class is used to populate land type in plan configuration UI.
CropType	This class represents crop system (e.g. Organic, Conventional) and responsible to make operation to physical data table ‘CropType’. This class is used to populate Crop System drop down in plan configuration screen.
CropDesc	This class represents crop name (e.g. Wheat, Corn etc) and responsible to

	make operation to physical data table 'CropDesc'. This class promotes reusing crop name for multiple plans. This class is used to populate crop list in plan configuration screen.
Crop	This class represents crop that has been configured for a plan and responsible to make operation to physical data table 'Crop. This is used to find out cost, income, profit.
Income	This class represents Income data of a given crop and responsible to make operation to physical data table 'Income'. This is used to calculate income, profit, CpsSummary and CPSAnalysis data.
Cost	This class represents Cost data of a given crop and responsible to make operation to physical data table 'Cost'. This is used to calculate cost, profit, CpsSummary, and CPSAnalysis data.

2.1.6 CPS Database Component

This component holds the physical CPS Database, the model of MVC design pattern. Below is the CPS database schema diagram outlines tables structures and the relationships among the tables.

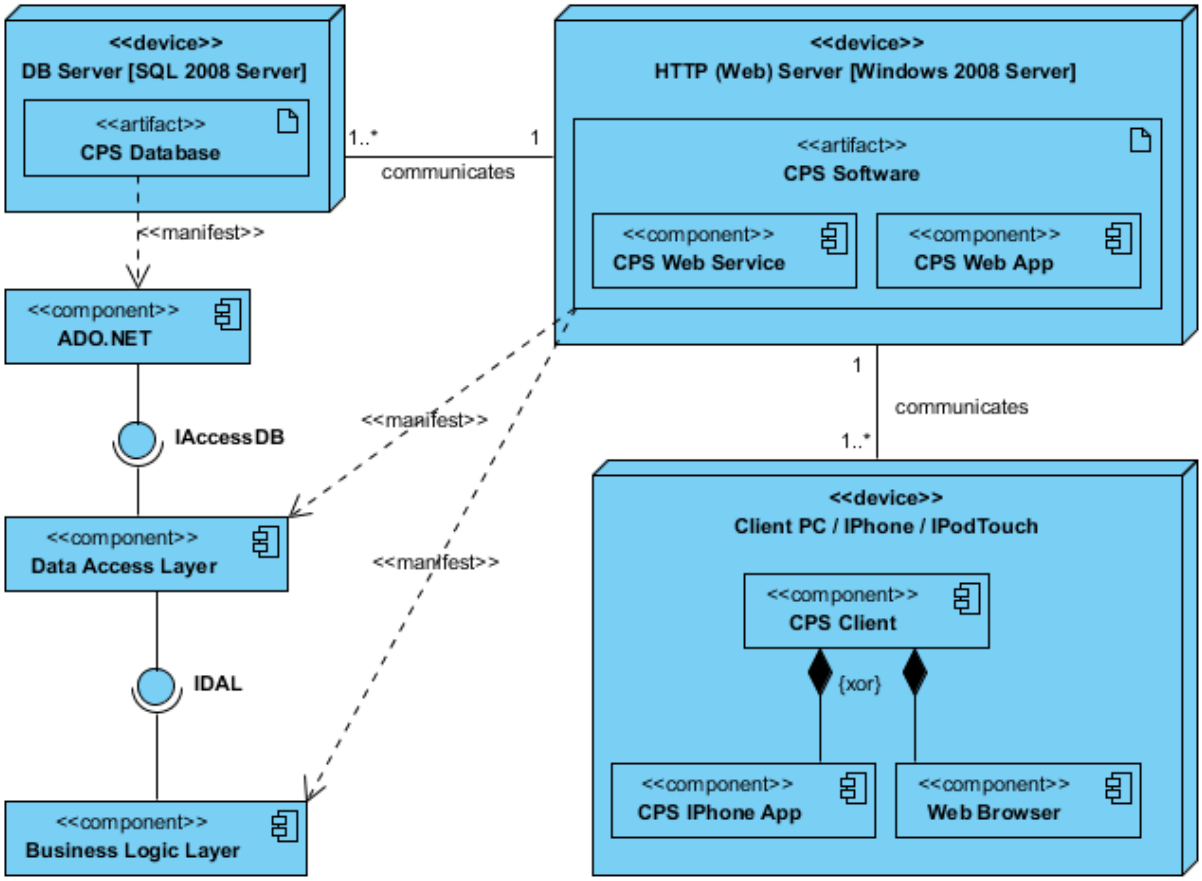
Figure 3.2.5 CPS Database Schema



2.2 Deployment View

This section provides deployment diagram of CPS software including both clients.

Figure 3.2.6 Deployment Diagram of CPS Software



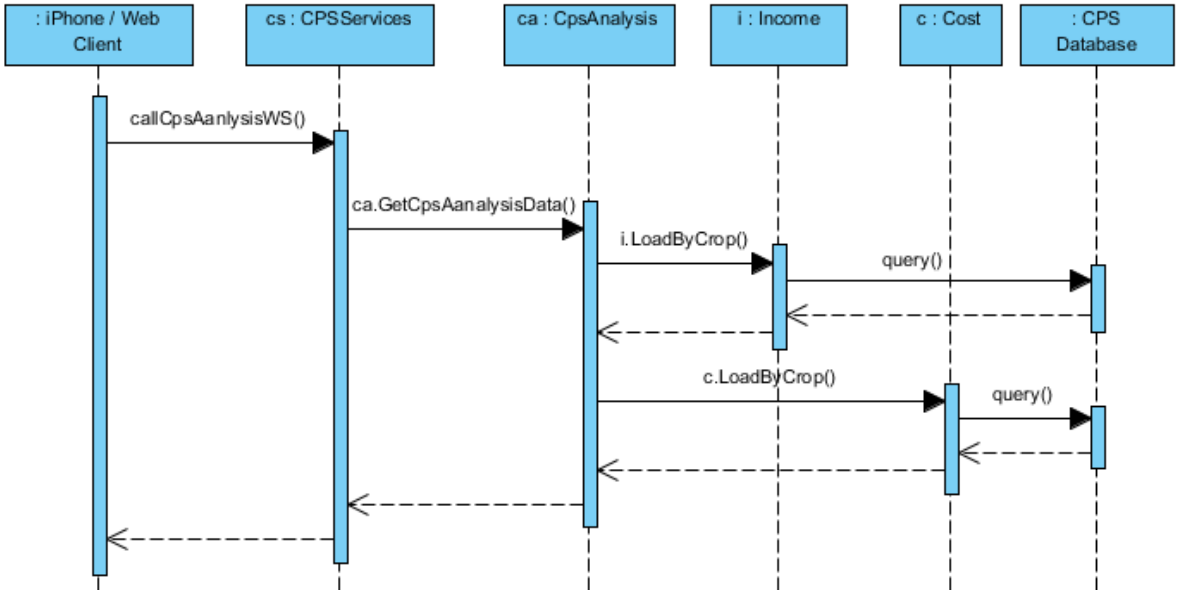
Description: CPS Client can be either an iPhone App running on the iPhone OS or a browser loaded with the CPS Web page running using any PC. iPhone app communicates with CPS Web service which then access to CPS Database either via BLL component or DAL component. For web browser client, it first sends the request to a web server, then it calls a web service via code-behind class of CPS Web App component to query data from the CPS database.

2.3 Interaction View

This section provides two sequence diagrams to demonstrate two path that web service may take query CPS database.

2.3.1 Sequence Diagram of View Summary Usecase

Figure 3.2.7 Sequence diagram of View Summary (CpsAnalysis) Usecase



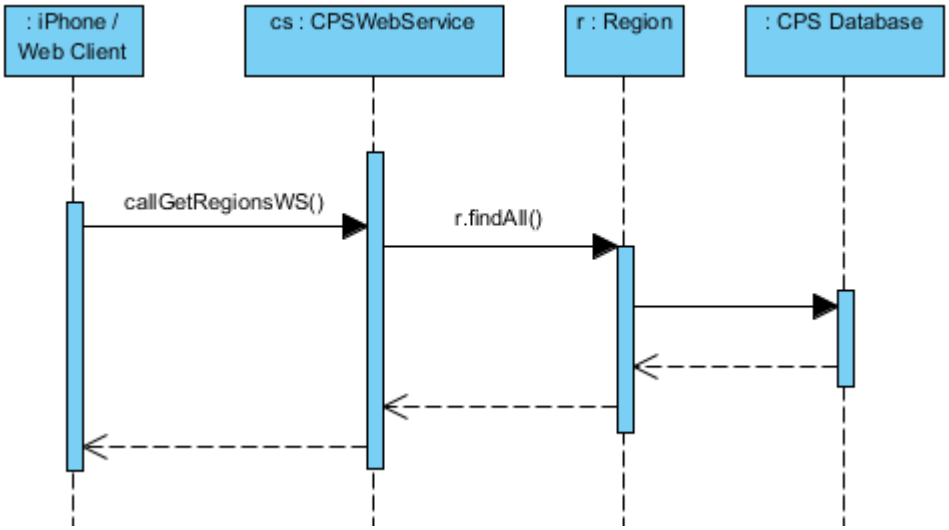
Description: Web / iPhone (client) invokes CpsAanlysis Web Service which is used to get data needed to display return over cost tables to do compare plan side-by-side. Web service, creates a CpsAnalysis object (which is omitted in the diagram for clarity) and call GetCpsAanalsysisData method. This method first creates income object and call LoadByCrop method which queries the database and load the income object. Then, it creates Cost object and call LoadByCrop method which queries the database and load cost object. CpsAnalysis object then does required calculation, build datatable structure and send data to CpsWebServices object. The web service then return response to the caller, the client.

2.3.2 Sequence Diagram of Select Region UseCase

Note: The diagram below is displayed to demonstrate different path that web service takes to query data from the database. In this case, the web service directly call object of

DAL to query the database and get the data, instead of using BLL object stated in 2.3.1 section above.

Figure 3.2.8 Sequence diagram of Get Regions



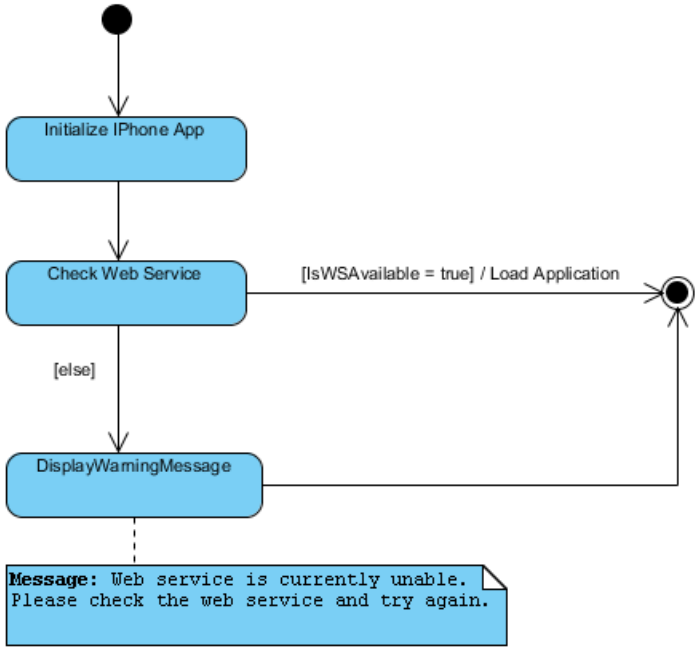
Description: Web / iPhone (client) invokes GetRegions Web Service to get list of regions that user may pick from. The service creates a Region object (creation of the object is omitted for clarity) and call findAll method which query the database and return the datatable with list of Regions to the web service. The web service then sends response to caller, the client with list of regions.

2.4 State Machine View

This section provides state machine diagram of CPS software.

2.4.1 State Machine Diagram of Loading CPS Application

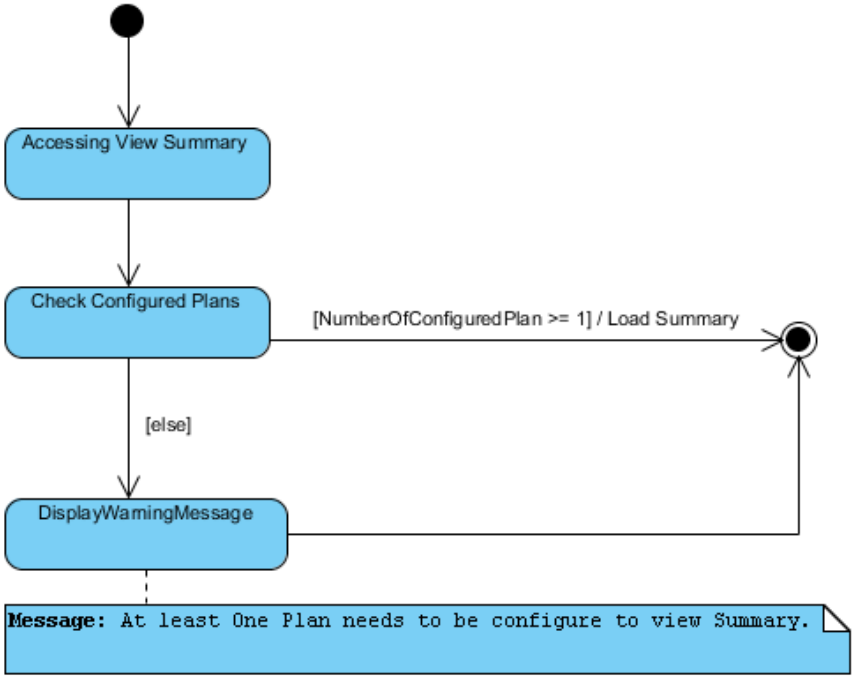
Figure 3.2.9 State Machine Diagram of Loading CPS Application


Initialize IPhone App
Check Web Service
[IsWSAvailable = true] / Load Application
[else]
DisplayWarningMessage
Message: Web service is currently unable.
Please check the web service and try again.

Description: When the iPhone app fires up, it first does the initialize routines, then it checks if the web service is available. If available, it gracefully loads the application. If the web service is not available or has an error during rendering the service, it displays the warning message.

2.4.2 State Machine Diagram of View Summary

Figure 3.2.10 State Machine Diagram of View Summary


Accessing View Summary
Check Configured Plans
[NumberOfConfiguredPlan >= 1] / Load Summary
[else]
DisplayWarningMessage
Message: At least One Plan needs to be configure to view Summary.

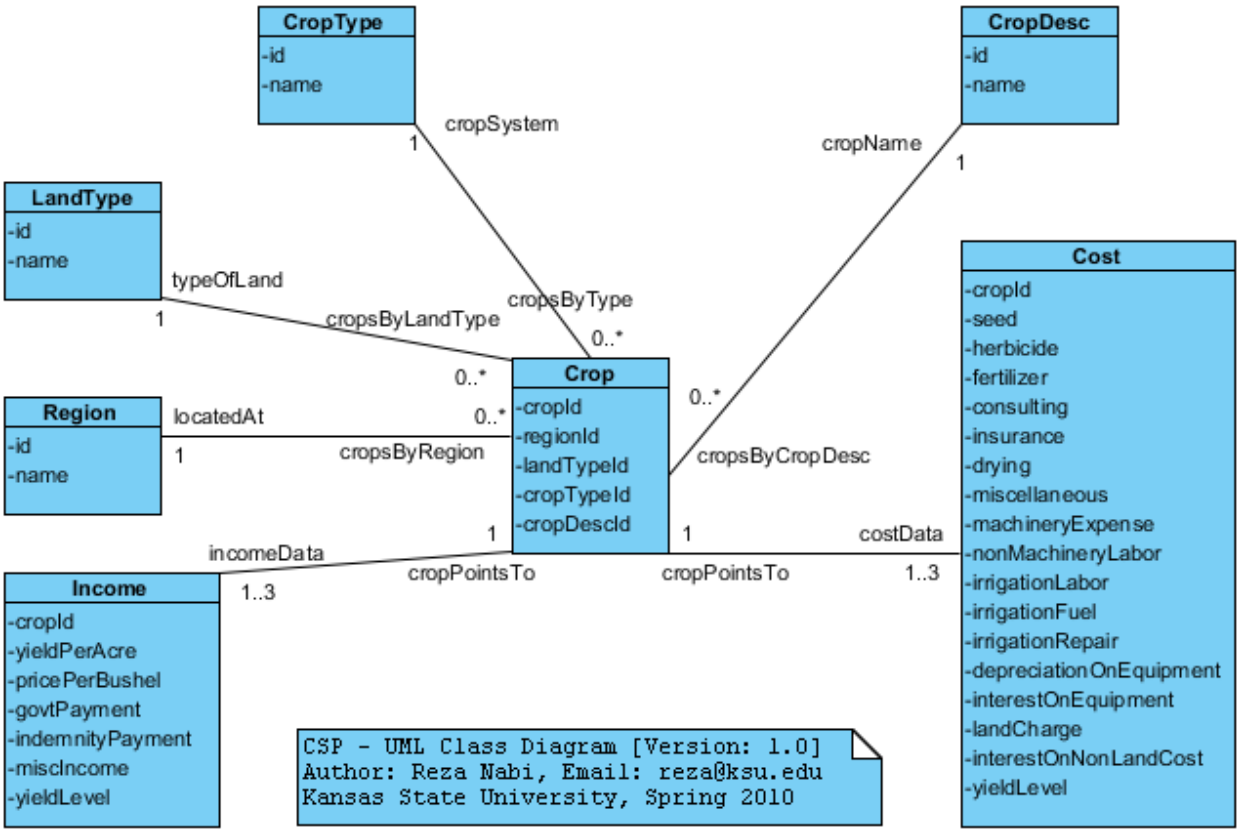
Description: When the user clicks on the Summary tab in the iPhone app, the system first checks if there is a plan configured. If there is at least one plan configured, the system loads the summary page gracefully. If no plans are configured, the system gives a warning message.

3 Formal Specification of the System

This section provides class diagram with role name used by model, USE model along with CMD scripts which is used to hold/violate invariants stated in the model.

3.1 UML Class Diagram with Role Name

Figure 3.3.1 UML Class Diagram with Role Name for Formal Specification



3.2 USE Model

```
-- ************************************************************
-- Formal Specification of CPS [Crop Profitability Simulator]
-- MSE Project, Spring 2010, Kansas State University
-- ************************************************************
-- File Name: cps.use
-- Author: Reza Nabi
-- Date: Mar 25, 2010
--
model CPSSystem

--
-- E N U M E R A T I O N S
--
enum YieldLevel {Average, High, Low}

--
-- C L A S S E S
--
-- Region is used to identify location of the land.
-- e.g. South West, North West, North Central etc.
-- Each Region will have a name and Active flag
-- When we don't want to support any entered region, we can just set
-- the active flag to false.

class Region
 attributes
   id     : Integer
   name   : String
end
```

```
-- CropDesc is used to hold the description of the crop
-- e.g. Corn, Wheat etc.

class CropDesc
 attributes
   id     : Integer
   name   : String
end

-- CropType is to hold the type of the crop also known as crop system
-- e.g. Organic, Conventional

class CropType
 attributes
   id    : Integer
   name  : String
end

-- LandType is to hold the type of the land
-- e.g. Dry, Irrigated

class LandType
 attributes
 id    : Integer
 name  : String
end

-- Crop is to hold details information of the crops
-- location of the land (region), type of land, crop type
-- description of the crop and an unique cropId.
-- The unique cropId is used to map with income and cost data
```

```
class Crop
 attributes
   cropId     : Integer
   landTypeId : Integer
   cropDescId : Integer
   cropTypeId : Integer
   regionId   : Integer
   --
   -- O P E R A T I O N S
   --
   operations

   -- Get the costs for a given crop
      getCostsByYieldLevel(yl : YieldLevel) : Set(Cost) =
      self.costData->select(cst | cst.yieldLevel = yl)

   -- Get the Incomes for a given crop
      getIncomesByYieldLevel(yl : YieldLevel) : Set(Income) =
      self.incomeData->select(incm | incm.yieldLevel = yl)
end

class Income
 attributes
   cropId          : Integer
   yieldPerAcre    : Real
   pricePerBushel  : Real
   govtPayment     : Real
   indemnityPayment : Real
   miscIncome      : Real
   yieldLevel      : YieldLevel
end
```

```
class Cost
 attributes
   cropId               : Integer
   seed                 : Real
   herbicide            : Real
   insecticide          : Real
   fertilizer           : Real
   consulting           : Real
   insurance            : Real
   drying               : Real
   miscellaneous        : Real
   machineryExpense     : Real
   nonMachineryLabor    : Real
   irrigationLabor      : Real
   irrigationFuel       : Real
   irrigationRepair     : Real
   depreciationOnEquipment : Real
   interestOnEquipment  : Real
   landCharge           : Real
   interestOnNonLandCost : Real
   yieldLevel           : YieldLevel

end
--
-- A S S O C I A T I O N S
--
-- Assocation between Region (e.g. North West, South West) and Crop
association LocationOfCrop between
 Region[1] role locatedAt
 Crop[0..*] role cropsByRegion
end
```

```
-- Assocation between CropType (e.g. Organic, Conventional) and Crop
association TypeOfCrop between
 CropType[1] role cropSystem
 Crop[0..*] role cropsByType
end
-- Assocation between LandType (e.g. Dry, Irrigate) and Crop
association LandTypeOfCrop between
 LandType[1] role typeOfLand
 Crop[0..*] role cropsByLandType
end
-- Association between Crop Description and Crop
association DescriptionOfCrop between
 CropDesc[1] role cropName
 Crop[0..*] role cropsByCropDesc
end

-- For each crop system should have at least one Income
-- It also makes sure Income does not have more than 3.
-- One for each yield level (e.g. Average, High, Low)
association CropIncomeMap between
 Crop[1] role cropPointsTo
 Income[1..3] role incomeData
end

-- For each crop system should have at least one cost
-- It also makes sure Cost does not have more than 3.
-- One for each yield level (e.g. Average, High, Low)
association CropCostMap between
 Crop[1] role cropPointsTo
 Cost[1..3] role costData
end
```

```
--
-- C O N S T R A I N T S
--
constraints

-- cropId in Crop must be unique
-- Constraints No: 1
context crp1:Crop inv CropIdIsUnique:
  Crop.allInstances->forAll(crp2|crp1.cropId=crp2.cropId
  implies  crp1=crp2)

-- System must have at least one Crop configured
-- At least one or more cost and income data is forced by
-- association CropCostMap and CropIncomeMap by multiplicity 1..3
-- Constraints No: 2
context Region inv HaveAtLeastOneCropCofigured:
   self.cropsByRegion->size >= 1
   and Region.allInstances->asSequence->size >= 1

-- For each Yield Level, make sure number of
-- Costs and Incomes are equal. This will help to make
-- sure the data is in sync.
-- NOTE: For fun... I made these functional and using them here :-)
-- Constraints No: 3
context crp:Crop inv CostAndIncomeDataMustBeInSync:
   crp.getCostsByYieldLevel(#Average)->size = crp.getIncomesByYieldLevel(#Average)-
>size
   and crp.getCostsByYieldLevel(#High)->size = crp.getIncomesByYieldLevel(#High)-
>size
   and crp.getCostsByYieldLevel(#Low)->size = crp.getIncomesByYieldLevel(#Low)-
>size
```

```
-- In Income, make sure cropId is unique for a given yieldLevel
-- Constraints No: 4
context incm1:Income inv NoDuplicateCropIdInIncomePerYieldLevel:
  Income.allInstances->forAll(incm2|incm1.cropId=incm2.cropId
  and incm1.yieldLevel=incm2.yieldLevel
  implies incm1=incm2)

-- In Cost, make sure cropId is unique for a given yieldLevel
-- Constraints No: 5
context cst1:Cost inv NoDuplicateCropIdInCostPerYieldLevel:
  Cost.allInstances->forAll(cst2|cst1.cropId=cst2.cropId
  and cst1.yieldLevel=cst2.yieldLevel implies cst1=cst2)

-- Make sure system at least has one region
-- Constraints No: 6
context Region inv AtleastHaveOneRegion:
  Region.allInstances->asSequence->size >= 1

 -- Make sure system at least has one Crop Type (e.g. Organic, Conventional)
 -- Constraints No: 7
 context CropType inv AtleastHaveOneCropType:
   CropType.allInstances->asSequence->size >= 1

 -- Make sure system at least has one Land Type (e.g. Dry, Irrigate)
 -- Constraints No: 8
 context LandType inv AtleastHaveOneLandType:
   LandType.allInstances->asSequence->size >= 1
```

3.3 Transcripts – Outcome of CMD Script to hold/violate invariants

Following are the outcome along with explanation of USE cmd scripts [refer to section 4 in formal specification document] which is used to instantiate the USE model and to hold/violate the invariants.

```
**************************************************************
* CPS - MSE Project
* Transcripts - The results of various runs CMD Scripts
* Author : Reza Nabi, Email: reza@ksu.edu
**************************************************************
============================================================
```

All Constraints Holds

```
Confirm basic instantiation satisfies all basic structure requirements
============================================================
SCRIPTS RAN:
use> read A-basic-init.cmd
------------------------------------------------------------
cps-basic-init.cmd>
use> check
checking structure...
checking invariants...
checking invariant (1) `Cost::NoDuplicateCropIdInCostPerYieldLevel': OK.
checking invariant (2) `Crop::CostAndIncomeDataMustBeInSync': OK.
checking invariant (3) `Crop::CropIdIsUnique': OK.
checking invariant (4) `Income::NoDuplicateCropIdInIncomePerYieldLevel': OK.
checking invariant (5) `Region::HaveAtLeastOneCropCofigured': OK.
checked 5 invariants in 0.020s, 0 failures.
use>
```

==========

Constraint No : 1 [CropIdIsUnique] Fails

Explanation: In crp3 object created with a cropId 1 which is used in crp1.

Hence, CropIdIsUnique constraint failed.

==========

SCRIPTS RAN:

use> read constraint-1-fails.cmd

---

constraint-1-fails.cmd> check

checking structure...

checking invariants...

checking invariant (1) `Cost::NoDuplicateCropIdInCostPerYieldLevel': OK.

checking invariant (2) `Crop::CostAndIncomeDataMustBeInSync': OK.

checking invariant (3) `Crop::CropIdIsUnique': FAILED.

-> false : Boolean

checking invariant (4) `Income::NoDuplicateCropIdInIncomePerYieldLevel': OK.

checking invariant (5) `Region::HaveAtLeastOneCropCofigured': OK.

checked 5 invariants in 0.010s, 1 failure.

constraint-1-fails.cmd>

use>

==========

Constraint No : 2 [HaveAtLeastOneCropCofigured] Fails

Explanation: There is no Crop configured. System requires that at least one

must be configured. Hence, constraint 2 failed.

==========

SCRIPTS RAN:

use> read constraint-2-fails.cmd

---

constraint-2-fails.cmd> check

checking structure...

checking invariants...

checking invariant (1) `Cost::NoDuplicateCropIdInCostPerYieldLevel': OK.

checking invariant (2) `Crop::CostAndIncomeDataMustBeInSync': OK.

checking invariant (3) `Crop::CropIdIsUnique': OK.

checking invariant (4) `Income::NoDuplicateCropIdInIncomePerYieldLevel': OK.

checking invariant (5) `Region::HaveAtLeastOneCropCofigured': FAILED.

-> false : Boolean

checked 5 invariants in 0.020s, 1 failure.

constraint-2-fails.cmd>

use>

==========

Constraint No : 3 [CostAndIncomeDataMustBeInSync] Fails

Explanation: As per the system requirement, for a given yield level, if a row exists in Income, there must be another row exists in Cost as well for the same yield level.

Here, for the crp3 (cropId 3), Income object is created with 'Average' yield level but Cost object is created with 'High' yield level.

Hence, constraint 3 failed.

==========

SCRIPTS RAN:

use> read constraint-3-fails.cmd

---

constraint-3-fails.cmd> check

checking structure...

checking invariants...

checking invariant (1) `Cost::NoDuplicateCropIdInCostPerYieldLevel': OK.

checking invariant (2) `Crop::CostAndIncomeDataMustBeInSync': FAILED.

-> false : Boolean

checking invariant (3) `Crop::CropIdIsUnique': OK.

checking invariant (4) `Income::NoDuplicateCropIdInIncomePerYieldLevel': OK.

checking invariant (5) `Region::HaveAtLeastOneCropCofigured': OK.

checked 5 invariants in 0.010s, 1 failure.

constraint-3-fails.cmd>

use>

==========

Constraint No : 3 [CostAndIncomeDataMustBeInSync] Fails

Explanation: As per the system requirement, for a given yield level, if a row exists in Income, there must be another row exists in Cost as well for the same yield level.

Here, for the crp3 (cropId 3), Income object is created with 'Average' yield level but Cost object is created with 'High' yield level.

Hence, constraint 3 failed.

==========

SCRIPTS RAN:

use> read constraint-3-fails.cmd

---

constraint-3-fails.cmd> check

checking structure...

checking invariants...

checking invariant (1) `Cost::NoDuplicateCropIdInCostPerYieldLevel': OK.

checking invariant (2) `Crop::CostAndIncomeDataMustBeInSync': FAILED.

-> false : Boolean

checking invariant (3) `Crop::CropIdIsUnique': OK.

checking invariant (4) `Income::NoDuplicateCropIdInIncomePerYieldLevel': OK.

checking invariant (5) `Region::HaveAtLeastOneCropCofigured': OK.

checked 5 invariants in 0.010s, 1 failure.

constraint-3-fails.cmd>

use>

==========

Constraint No : 4 [NoDuplicateCropIdInIncomePerYieldLevel] Fails

Explanation: In incm3, cropId 2 and yield level 'Average' is used intentionally to break the constraint. As per the requirement for a given yield level, Income cannot have duplicate cropId. In this case, cropId 2 is used in incm2 object. Hence, constraint 4 will not hold.

==========

SCRIPTS RAN:

```
use> read constraint-4-fails.cmd
------------------------------------------------------------
constraint-4-fails.cmd> check
checking structure...
checking invariants...
checking invariant (1) `Cost::NoDuplicateCropIdInCostPerYieldLevel': OK.
checking invariant (2) `Crop::CostAndIncomeDataMustBeInSync': OK.
checking invariant (3) `Crop::CropIdIsUnique': OK.
checking invariant (4) `Income::NoDuplicateCropIdInIncomePerYieldLevel': FAILED.

  -> false : Boolean
checking invariant (5) `Region::HaveAtLeastOneCropCofigured': OK.
checked 5 invariants in 0.010s, 1 failure.
constraint-4-fails.cmd>
use>
```

==========

Constraint No : 5 [NoDuplicateCropIdInCostPerYieldLevel] Fails

Explanation: In cst3, cropId 2 and yield level 'Average' is used intentionally to break the constraint. As per the requirement for a given yield level, Cost cannot have duplicate cropId. In this case, cropId 2 is used in cst2 object. Hence, constraint 5 will not hold.

==========

SCRIPTS RAN:

```
use> read constraint-5-fails.cmd
------------------------------------------------------------
constraint-5-fails.cmd> check
checking structure...
checking invariants...
checking invariant (1) `Cost::NoDuplicateCropIdInCostPerYieldLevel': FAILED.
  -> false : Boolean
checking invariant (2) `Crop::CostAndIncomeDataMustBeInSync': OK.
checking invariant (3) `Crop::CropIdIsUnique': OK.
checking invariant (4) `Income::NoDuplicateCropIdInIncomePerYieldLevel': OK.
checking invariant (5) `Region::HaveAtLeastOneCropCofigured': OK.
checked 5 invariants in 0.030s, 1 failure.
constraint-5-fails.cmd>
use>
```

CHAPTER 4 - INSPECTION LIST

1 Introduction

This chapter provides a checklist that is used to perform a technical inspection of the MSE Project developing CPS Software. It provides a guideline that is to be followed while inspectors check the integrity of artifacts associated with this project. The inspectors will use this document as an aid while inspecting the Architectural Design Document 1.0 and USE Model.

2 Items to be inspected

Following are items that need to be inspected by the technical reviewer.

2.1 UML Diagrams

- Class Diagram
- Sequence Diagram
- Component Diagram
- Deployment Diagram
- State Machine Diagram
- Use Case Diagrams

2.2 Formal Specifications

- USE Model
- Scripts to test Model

3 Formal Inspectors

1 Amit Borcar, Software Engineer, Sage Software

Email: amit.borcar@sage.com

2 Suresh Pothuri, Software Engineer, Sage Software

Email: suresh.pothuri@sage.com

4 Formal Inspection Checklist

Table 4.4.1 Formal Inspection Checklist

	Inspection Item	Artifact	Results	Comments
I.1	The symbols used in the class diagrams conform to UML standards.	Architectural Design 1.0		
I.2	The symbols used in the sequence diagrams, state machine diagram, use case diagram conforms to UML standards.	Architectural Design 1.0		
I.3	The symbols used in the component view diagram conform to UML standards.	Architectural Design 1.0		
I.4	The symbols used in deployment diagram conform to UML standards.	Architectural Design 1.0		
I.5	The USE model, associations, and invariants are sufficient to meet the requirement outlined in section 3.1 and section 3.2 in vision document.	USE Model - Formal Specification 1.0		
I.6	The USE instantiation scripts and other CMD scripts provided with USE model is sufficient to verify the invariants (to holds / violates).	USE Model - Formal Specification 1.0		
I.7	Test CPS Software and verify that it meets all functional requirements stated in section 3.1 and 3.2 in vision document. **NOTE:** This item will help to maintain supplier control guideline stated in Quality Assurance Plan Document 1.0.	CPS Software		

CHAPTER 5 - COMPONENT DESIGN

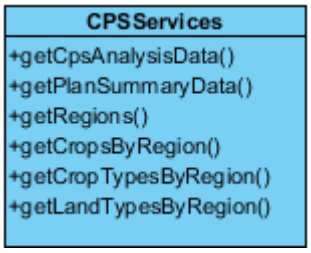
1 Introduction

The purpose of this chapter is to outline the internal design of server side components such as Web Service Component, Data Access Layer Component (DALC) and Business Logic Layer Component (BLLC) that we discussed briefly (high level) in section 2 of Chapter 3, Architecture Design. For a component diagram of the whole CPS Software, please refer to Figure 3.2.1 Component Diagram of CPS Software in chapter 3.

2 Web Service Component (WSC)

This section provides class diagram of Web Service Component and detailed description of each class. WSC is responsible serves the client's (Web Client or iPhone Clinet) request using BLLC or DALC based on the type of the request.

Figure 5.2.1 Class Diagram of Web Service Component



2.1 CPSServices Class

2.1.1 Description

CPSServices class is the heart of SOA. This class implements all the required web methods (web service) to facilitate clients (Web app or iPhone app) to have access to BLL (Business Logic Layer), (Data Access Layer) components and Database Component and return the results to the caller (client).

2.1.2 Attributes

No attribute is required for this web service class as this class is designed to have only web methods.

2.1.3 Operation Specification of non getter/setter/constructor method

Table 5.2.1 Operation specification of CPSServices Class

Method Name	Description	
GetRegions	Signature	`public DataTable GetRegions()`
	Description	This method returns list of Regions found in the database.
	Behavior	Pre: None Post: return datatable of regions found in the database. Post: if no regions found, return null and give user “at least one region must be configured” message.
GetCropsByRegion	Signature	`public DataTable GetCropsByRegion(string regionName)`
	Description	This method returns list of Crops found in the database for a given region.
	Behavior	Pre: passed in data is valid Post: return datatable of Crops if records found in the database. Post: if no crops are found for a given region, return null and give user “At least one crop needs to be configured for a given region” message.
GetCropTypesByRegion	Signature	`public DataTable GetCropTypesByRegion (string regionName)`
	Description	This method returns list of CropTypes configured in the database for a given region.
	Behavior	Pre: passed in data is valid Post: return datatable of CropType if records found in the database. Post: if no CropTypes are found for a given

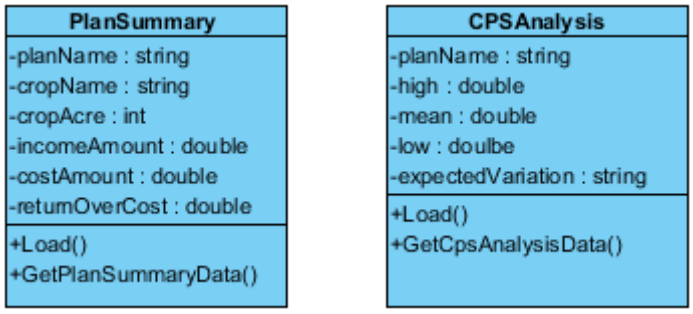
		region, return null and give user “At least one CropType needs to be configured for a given region” message.
GetLandTypesByRegion	Signature	`public DataTable GetLandTypesByRegion (string regionName)`
	Description	This method returns list of LandTypes configured in the database for a given region.
	Behavior	Pre: passed in data is valid Post: return datatable of LandType if records found in the database. Post: if no LandTypes are found for a given region, return null and give user “At least one LandTypes needs to be configured for a given region” message.
GetPlanSummaryData	Signature	`public DataTable GetPlanSummaryData(string regionName, string cropName, string landType, string cropType, string sYieldChange, string sPriceChange, string sCostChange, string landArea)`
	Description	This method returns the plan summary datatable.
	Behavior	Pre: Passed in data is valid Post: return datatable with PlanSummary data Post: if invalid data found, return null and give user “invalid data” message.
GetCpsAnalysisData	Signature	`public DataTable GetCpsAnalysisData(string regionName, string cropName, string landType, string cropType, string sYieldChange, string sPriceChange, string sCostChange, string planName)`
	Description	This method returns the datatable of CpsSummary data which is used to draw graph and retune over cost tables for all plans side by side.
	Behavior	Pre: Passed in data is valid

		Post: return datatable with CpsSummary data Post: if invalid data found, return null and give user “invalid data” message.

3 Business Logic Layer Component (BLLC)

This section provides class diagram of Business Logic Layer Component and detailed description of each class. BLLC is responsible implement business rules and communicate with DALC to query or save information to Physical CPS database.

Figure 5.3.1 Class diagram of Business Logic Layer Component



3.1 PlanSummary

3.1.1 Description

This user defined data structure helps to represent plan summary data displayed with user configure a plan. In this project, the PlanSummary BLL class is used by web client only. The method GetPlanSummaryData() is used to return dataset to display complete plan summary.

3.1.2 Attributes

Table 5.3.1 Attributes of PlanSummary Class

Name	Type	Description
planName	string	Plan Description
cropName	string	Crop Name
acreAmount	int	Crop Acre

incomeAmount	double	Income Amount
costAmount	double	Cost Amount
returnOverCost	double	Profit, the return over cost

3.1.3 Operation Specification of non getter/setter/constructor method

Table 5.3.2 Operation specification of PlanSummary Class

Method Name	Description	
GetPlanSummary	Signature	`public DataTable GetPlanSummaryData(Crop crp, int landArea, Cost c, Income i)`
	Description	It takes Crop, landArea, Cost and Income object and it calculates as per the business rule and return PlanSummary datatable.
	Behavior	Pre: Passed in data is valid Post: return plan summary datatable. Post: if invalid data found, return null and give user "invalid data" message.
Load	Signature	`public bool Load(Cost c, Income i, string planName)`
	Description	It loads the PlanSummary object. Returns to true if all data passed in is valid and load successful. Otherwise return false.
	Behavior	Pre: Passed in data is valid Post: return true load successful meaning all data is valid. Otherwise return false Post: give user "Invalid data" message if load unsuccessful.

3.2 CPSAnalysis

3.2.1 Description

This helps to represent CPSAnalysis data which is used to draw graph and display overall return over costs with High, Low, Mean value (if expected variation entered) for multiple plans side-by-side.

3.2.2 Attributes

Table 5.3.3 Attributes of CPSAnalysis Class

Name	Type	Description
planName	string	Plan Description
expectedVariation	string	Expected variation applied to user's estimate
High	double	Highest profit user may have
Mean	double	Average profit
Low	double	Lowest profit user may have

3.2.3 Operation Specification of non getter/setter/constructor method

Table 5.3.4 Operation specification of CPSAnalysis Class

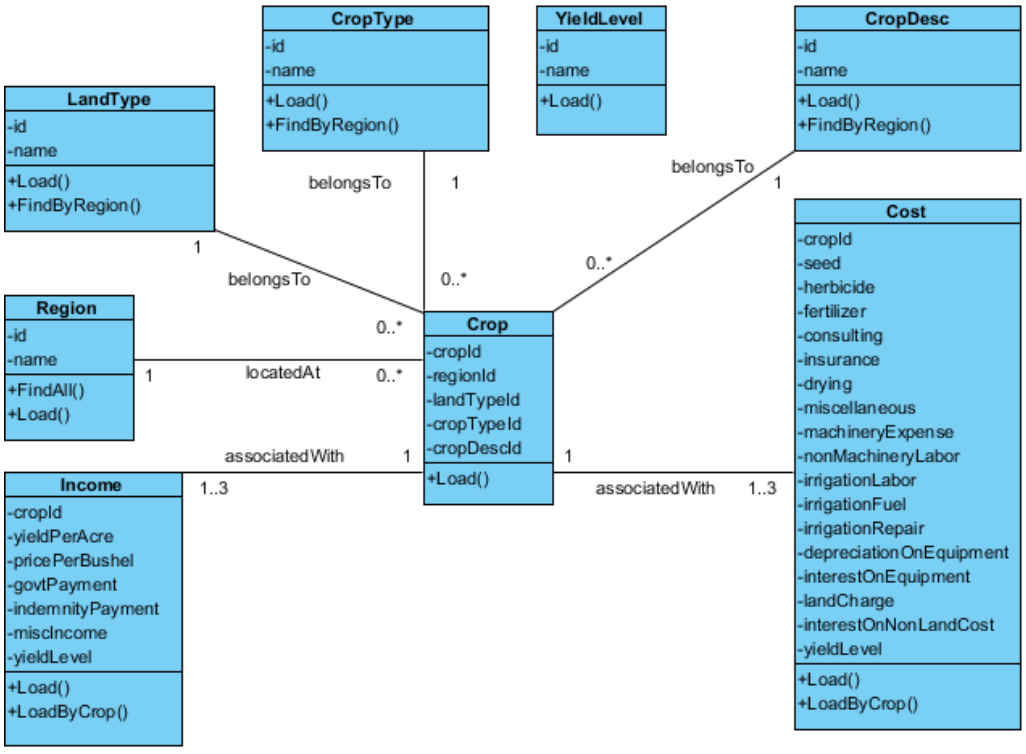
Method Name	Description	
GetAnalysisData	Signature	`public DataTable GetAnalysisData(Cost c, Income i, string planName)`
	Description	It takes Cost, Income and planName and it calculates as per the business rule and return CPSAnalysis datatable.
	Behavior	Pre: Passed in data is valid Post: return datatable with CPSAnalysis data Post: if invalid data found, return null and give user "invalid data" message.
Load	Signature	`public bool Load(Cost c, Income i, string planName)`
	Description	It loads the CPSAnalysis object. Returns to true if all data passed in is valid and load successful. Otherwise return false.

	Behavior	Pre: Passed in data is valid Post: return true load successful meaning all data is valid. Otherwise return false Post: give user “Invalid data” message if load unsuccessful.

4 Data Access Layer Component (DALC)

This section provides class diagram of Data Access Layer Component and detailed description of each class. DALC is responsible to communicate with Physical CPS database.

Figure 5.4.1 – Class diagram of Data Access Layer Component



4.1 Region Class

4.1.1 Description

This class represents location of the land (e.g. North West, South West etc.) and responsible to make operation to physical data table 'Region'. This class is used to list the locations (region) of crop in both clients.

4.1.2 Attributes

Table 5.4.1 Attributes of Region Class

Name	Type	Description
regionId	Int	Region's ID
name	String	Description of Region (e.g. North West)

4.1.3 Operation Specification of non Getter/Setter/Constructor method

Table 5.4.2 Operation specification of Region Class

Name	Description	
Load	Signature	`public bool Load(int id)`
	Description	It loads the Region object. Returns to true if data passed in is valid and load successful. Otherwise return false.
	Behavior	Pre: Passed in data is valid Pre: a record should exist in region table by the id passed in. Post: return true if record exists and load successful. Otherwise return false Post: give user "record not found" message if record does not exists.
FindAll	Signature	`public DataTable FindAll()`
	Description	It finds all the regions available in Region table and returns the datatable of regions.
	Behavior	Pre: None Post: return list of regions found in the system. Post: If no region exists then return null and give user "record

		not found” message

4.2 LandType Class

4.2.1 Description

This class represents type of the land (e.g. Dry, Irrigated etc) and responsible to make operation to physical data table ‘LandType’. This class is used to populate land type in plan configuration UI.

4.2.2 Attributes

Table 5.4.3 Attributes of LandType Class

Name	Type	Description
landTypId	Int	Land Type’s ID
Name	String	Description of Land Type (e.g. Dry, Irrigated)

4.2.3 Operation Specification of non getter/setter/constructor method

Table 5.4.4 Operation specification of LandType Class

Name	Description	
Load	Signature	`public bool Load(int id)`
	Description	It loads the LandType object. Returns to true if data passed in is valid and load successful. Otherwise return false.
	Behavior	Pre: Passed in data is valid Pre: a record should exist in LandType table by the id passed in. Post: return true if record exists and load successful. Otherwise return false Post: give user “record not found” message if record

		does not exists.
FindByRegion	Signature	`public DataTable FindByRegion(string regionName)`
	Description	It finds all the landTypes configure for a given region and retuns the datatable.
	Behavior	Pre: None Post: return list of landtypes configured for a given region. Post: If no landType configured then returns null and give user “at least one landtype needs to be configured for a given region” message

4.3 CropDesc Class

4.3.1 Description

This class represents crop name (e.g. Wheat, Corn etc) and responsible to make operation to physical data table ‘CropDesc’. This class promotes reusing crop name for multiple plans. This class is used to populate crop list in plan configuration screen.

4.3.2 Attributes

Table 5.4.5 Attributes of CropDesc Class

Name	Type	Description
cropDescId	Int	Crop Description ID
Name	String	Name of the Crop (e.g. Corn, Wheat, Soybean etc)

4.3.3 Operation Specification of non getter/setter/constructor method

Table 5.4.6 Operation specification of CropDesc Class

Name	Description	
Load	Signature	`public bool Load(int id)`
	Description	It loads the CropDesc object. Returns to true if data

		passed in is valid and load successful. Otherwise return false.
	Behavior	Pre: Passed in data is valid Pre: a record should exist in CropDesc table by the id passed in. Post: return true if record exists and load successful. Otherwise return false Post: give user “record not found” message if record does not exists.
FindByRegion	Signature	`public DataTable FindByRegion(string regionName)`
	Description	It finds all the CropNames configured for a given region and retuns the datatable.
	Behavior	Pre: None Post: return list of Crop names configured for a given region. Post: If no crop name configured then returns null and give user “at least one crop must be configured for a given region” message

4.4 Crop Class

4.4.1 Description

This class represents crop that has been configured for a plan and responsible to make operation to physical data table ‘Crop. This is used to find out cost, income, profit.

4.4.2 Attributes

Figure 5.2.7 Attributes of Crop Class

Name	Type	Description
cropId	Int	Unique Crop Id
landTypeId	Int	Land type that the crop associated with

cropTypeId	Int	Crop Type that the Crop associated with
cropDescId	Int	Crop Description that the Crop associated with

4.4.3 Operation Specification of non getter/setter/constructor method

Figure 5.2.6 Operation specification of Crop Class

Name	Description	
Load	Signature	`public bool Load(int cropDesId, int cropTypeId, int landTypeId, int regionId)`
	Description	It loads the crop object. Returns to true if all data passed in is valid and load successful. Otherwise return false.
	Behavior	Pre: Passed in data is valid Pre: a record should exists in the table class represent Post: return true if record exists and load successful. Otherwise return false Post: give user “record not found” message if record does not exists.

4.5 Income Class

4.5.1 Description

This class represents Income data of a given crop and responsible to make operation to physical data table ‘Income’. This is used to calculate income, profit, CpsSummary and CPSAnalysis data.

4.5.2 Attributes

Table 5.4.7 Attributes of Income Class

Name	Type	Description
cropId	int	Crop Id that the income records map to
yieldPerAcre	int	Yield per Acre
pricePerBushel	double	Price per bushel
govtPayment	double	Government payment

indemnityPayment	double	Indemnity Payment
miscIncome	double	Miscellaneous income
yieldLevelId	int	Yield level
returnPerAcre	double	Default (average) return per acre
highEndReturn	double	The highest return user may have based on the expected variation data. This is calculated field.
lowEndReturn	double	The lowest return user may have based on the expected variation data. This is calculated field.

4.5.3 Operation Specification of non getter/setter/constructor method

Table 5.4.8 Operation specification of Income Class

Name	Description	
LoadByCrop	Signature	`public bool LoadByCrop(string regionName, string cropName, string landType, string cropType, int yieldChange, int priceChange, int yiedLevelId)`
	Description	It loads the Income object. Returns to true if all data passed in is valid and load successful. Otherwise return false. **Usage:** This method is used by iPhone client where it only needed to return the default (found in the database) income value based on the given crop configuration.
	Behavior	Pre: Passed in data is valid Pre: a record should exists in the table class represent Post: return true if record exists and load successful. Otherwise return false Post: give user “record not found” message if record does not exists.
Load	Signature	`public bool Load(double yieldPerAcre, double pricePerBushel, double govtPayment, double indemnityPayment, double miscPayment, int yieldChange, int priceChange)`
	Description	It loads the Income object. Returns to true if all data

		passed in is valid and load successful. Otherwise return false. **Usage**: This method is used by Web client where user is allowed to have custom income data applied to user's farm.
	Behavior	Pre: Passed in data is valid Pre: a record should exists in the table class represent Post: return true load successful meaning all data valid. Otherwise return false Post: give user "Invalid data" message if load unsuccessful.

4.6 Cost Class

4.6.1 Description

This class represents Cost data of a given crop and responsible to make operation to physical data table 'Cost'. This is used to calculate cost, profit, CpsSummary, and CPSAnalysis data.

4.6.2 Attributes

Table 5.4.9 Attributes of Cost Class

Name	Type	Description
cropId	int	Crop Id that the Cost record map to
yieldPerAcre	int	Yield per Acre
Seed	double	Cost of Seed
herbicide	double	Cost of Herbicide
insecticide	double	Cost of Insecticide
fertilizer	double	Cost of Fertilizer
consulting	double	Cost of Consulting
insurance	double	Cost of Insurance

Drying	double	Cost of drying
miscellaneous	double	Miscellaneous Cost
machineryExpense	double	Machinery Expense
nonMachineryLabor	double	Non Machinery Labor
irrigationLabor	double	Irrigation Labor
irrigationFuel	double	Cost of Irrigation Fuel
irrigationRepair	double	Cost of Irrigation Repair
depreciationOnEquipment	double	Depreciation On Equipment Cost
interestOnEquipment	double	Interest paid on Equipment
landCharge	double	Land Charge
interestOnNonLandCost	double	Interest paid on Non Land Cost
subTotalCostPerAcre	double	Calculated field
totalCostPerAcre	double	Calculated average cost
highEndCost	double	Calculated highest cost
lowEndCost	double	Calculated lowest cost

4.6.3 Operation Specification of non getter/setter method

Table 5.4.10 Operation specification of Cost Class

Name	Description	
LoadByCrop	Signature	`public bool LoadByCrop(string regionName, string cropName, string landType, string cropType, int costChange, int yiedLevelId)`
	Description	It loads the Cost object. Returns to true if all data passed in is valid and load successful. Otherwise return false. **Usage:** This method is used by iPhone client where it only needed to return the default (found in the database) income value based on the given crop configuration.
	Behavior	Pre: Passed in data is valid Pre: a record should exists in the table class represent Post: return true if record exists and load successful. Otherwise return false

		Post: give user “record not found” message if record does not exists.
Load	Signature	`public bool Load(double seed, double herbicide, double insecticide, double fertilizer, double consulting, double insurance, double drying, double miscellaneous, double machineryExpense, double nonMachineryLabor, double irrigationLabor, double irrigationFuel, double irrigationRepair, double depreciationOnEquipment,double interestOnEquipment, double landCharge, double interestOnNonLandCost, double costChange)`
	Description	It loads the Cost object. Returns to true if all data passed in is valid and load successful. Otherwise return false. **Usage**: This method is used by Web client where user is allowed to have custom income data applied to user’s farm.
	Behavior	Pre: Passed in data is valid Pre: a record should exists in the table class represent Post: return true load successful meaning all data valid. Otherwise return false Post: give user “Invalid data” message if load unsuccessful.

4.7 CropType Class

4.7.1 Description

This class represents Crop type (e.g. Conventional, organice) and responsible to make operation to physical data table ‘CropType. This class is used to populate Crop type in plan configuration UI.

4.7.2 Attributes

Table 5.4.11 Attributes of CropType Class

Name	Type	Description
cropTypId	Int	CropTypes’ ID
Name	String	Description of CropType (e.g. Conventional, Organic)

4.7.3 Operation Specification of non getter/setter/constructor method

Table 5.4.12 Operation specification of CropType Class

Name	Description	
Load	Signature	`public bool Load(int id)`
	Description	It loads the CropType object. Returns to true if data passed in is valid and load successful. Otherwise return false.
	Behavior	Pre: Passed in data is valid Pre: a record should exist in CropType table by the id passed in. Post: return true if record exists and load successful. Otherwise return false Post: give user “record not found” message if record does not exists.
FindByRegion	Signature	`public DataTable FindByRegion(string regionName)`
	Description	It finds all the CropTypes configure for a given region and retuns the datatable.
	Behavior	Pre: None Post: return list of CropType configured for a given region. Post: If no CropType configured then returns null and give user “at least one CropType needs to be configured for a given region” message

4.8 YieldLevel Class

4.8.1 Description

This class represents level of Yield a farm produce (e.g. Average, High and Low). This class is responsible to make operation to physical data table 'YieldLevel'. Currently, our database only have data that belongs to 'Average' yield level. In future, we have plan to store Farm management guide data for other yield level as well.

4.8.2 Attributes

Table 5.4.13 Attributes of YieldLevel Class

Name	Type	Description
yieldLevelId	Int	Yield Level ID
Name	String	Description of Yield Level (e.g. Average, High, Low)

4.8.3 Operation Specification of non getter/setter/constructor method

Table 5.4.14 Operation specification of YieldLevel Class

Name	Description	
Load	Signature	`public bool Load(int id)`
	Description	It loads the YieldLevel object. Returns to true if data passed in is valid and load successful. Otherwise return false.
	Behavior	Pre: Passed in data is valid Pre: a record should exist in YieldLevel table by the id passed in. Post: return true if record exists and load successful. Otherwise return false Post: give user "record not found" message if record does not exists.

CHAPTER 6 - SOFTWARE QUALITY ASSURANCE PLAN

1 Purpose

This document is produced to outline the necessary steps to ensure the project has an acceptable level of quality. It will describe the necessary steps taken to ensure quality throughout the entire life-cycle process for this project.

2 Management

2.1 Organization

Below is a listing of the organization and their roles with the MSE project for developing CPS Software.

Developer:	Mr. Reza Nabi
Major Professor:	Dr. Daniel Andresen
Supervisory Committee:	Dr. Daniel Andresen Dr. Mitchell Neilsen Dr. Hikaru Peterson
Formal Technical Inspectors:	Mr. Amit Borcar, Software Engineer, Sage Software Mr. Suresh Pothuri, Software Engineer, Sage Software

2.2 Tasks

All project tasks are outlined in Project Plan document in Chapter 2.

2.3 Responsibilities

2.3.1 Developer

The developer is responsible for documentation, implementation, and testing of this project. Three presentations will be given detailing project progress. Bi-weekly

meetings with the major professor are required; these meeting are also open to all member of the committee.

2.3.2 Major Professor

The major professor is responsible for overseeing the work done by the developer. S/he must approve all artifacts of the project and is considered the end-user for agent Tool III's validation. S/he will also provide guidance and advice to the developer throughout the project's lifetime.

2.3.3 Supervisory Committee

The supervisory committee is responsible for preparing for and attending each of the three presentations. The committee will provide comments on the artifacts presented during the presentation and feedback is expected at these times.

2.3.4 Formal Technical Inspector

The formal technical inspectors are responsible for completing a formal inspection of the project framework. They will also conduct a preliminary functional walkthrough of the project.

3 Documentation

All documentation will be available at http://cis895.nabi.us/ .

3.1 Purpose

The purpose of the project documentation is to provide a reference and timeline for this project. Other project documentation may be required; this is at the discretion of the project developer and major professor. The current state of the documentation will be evaluated by the major professor within each phase of the development and must be approved by all committee members at the conclusion of each phase.

3.2 Minimum Documentation Requirements

Table 6.3.1 List of documentation required for each phase

Phase I	Phase II	Phase III
Project Plan 1.0	Project Plan 2.0	Component Design 1.0
Vision Document 1.0	Vision Document 2.0	Formal Inspection Letters
SQAP 1.0	Test Plan 1.0	Project Evaluation 1.0
	Formal Inspection Check List	Project Source Code
	Formal Requirement Specification	User Manual 1.0
	Architectural Document 1.0	Executable Project
	Executable Architecture Prototype	

4 Standards, Practices, Convention and Metrics

IEEE standards will be followed for documents when applicable throughout this project. C# naming conventions and practices will be followed for all project coding. COCOMO will be used as a cost estimate metric.

5 Reviews and Audits

All artifacts produced will be reviewed and assess by the supervisory committee. This includes all documents and executable project code. The artifacts will be evaluated at the conclusion of each phase, which is marked by one of the three presentations.

6 Testing

Test Plan 1.0 will out-line testing procedures and expected results of all test. Please refer to this document for further detail.

7 Problem Reporting and Corrective Actions

All problems will be reported as a result of presentations or brought about by the major professor. They will be compiled into an action document after each presentation and will be resolved prior to the next presentation.

8 Tools, Techniques and Methodologies

Following tools will be used during the proposed CPS Software development.

- Microsoft Visual Studio .NET 2008 IDE – for coding web app and web services
- XCode – IDE for iPhone application development
- C# - for coding web app and web services
- SQL – for web app, web service and database development
- Objective C – for coding iPhone application
- Cocoa – Framework for iPhone application development
- .NET Framework 3.5 – for web app and web service development
- .MVC – design pattern to develop iPhone application and web application
- JavaScript – for coding web app
- HTML – for coding web app
- XML – for coding web app, iPhone app, web services
- CSS – for coding web app
- IIS – for web server to serve web application and web service
- MS SQL SERVER 2008 – for database server
- MS Word 2007 – for documentation
- VersionOne – for Project Planning / Tracking / Burndown chart
- USE 2.3.1 and OCL – for formal specification and verification

9 Code Control

No version control system is used for the project yet. Developer takes manual effort to maintain different version of the source code.

10 Media Control

No formal process has been adopted to control the media for this project.

11 Record Collection, Maintenance and Retention

Two copies of all deliverables will be produced. One will be with the Major Professor, and one will be with the developer. In addition, the entire source code, documentation, and web pages for the project website will also be burned into CD and will be kept with the developer.

12 Training

If Major Professor wishes, developer will be conducting the training to the farmers/users.

13 Risk Management

Both the developer and Major Professor have primary responsibility for identifying and mitigating risks during the project. Any risks identified during the development will be reported at each weekly meeting/report.

CHAPTER 7 - TEST PLAN

1 Introduction

This document provides the plan for testing all the features (outlined in section 3.1 and section 3.2 in vision document, Chapter 1) of Crop Profitability Simulator (CPS) software. The document will also describe the activities and environment related to testing the software.

2 Test Items

- CPS Web application features stated in section 3.1 in vision document, Chapter 1.
- CPS iPhone application features stated in section 3.2 in vision document, Chapter 1.

3 Tested Features

All features of CPS Web application and CPS iPhone application will be tested. The features are outlined in section 3.1 (Web application) and section 3.2 (iPhone application) in CPS Vision Document, Chapter 1.

4 Features Not To Be Tested

Non functional requirements outlined in section 4 in vision document, chapter 1, will not be tested.

5 Approach

To test the CPS Software, the user will perform a set of actions or “Test Scenarios”. The scenarios will be evaluated by the visual results of the action performed. The user will verify the result of each scenario with the “Expected Outcome” provided in section 10, Testing Task.

6 Item Pass/Fail Criteria

For reach requirement, a test suite is provided in section 10, Testing Task. Each test suite will be considered successful if the outcome met the requirement stated in vision document and the result matches the expected outcome stated in test suite.

7 Suspension Criteria and Resumption Requirement

7.1 Suspension Criteria

If a test case fails, all further testing will be suspended and failure will be logged into the testing log document, a deliverable for the tester.

7.2 Resumption Requirement

For post test case failure, testing will resume only after the failure has been logged in test log document and the solution of the failure is found and the fix is included in the source code as well as in the build.

8 Test Deliverables

The deliverables that will be produced by the tester upon completing test of CPS Software are: (i) Test Log (ii) Test Plan

Each test must be recorded as either as “pass” or “fail”. All failed test will contain detailed description of the failure, date, time along with comments, if any.

9 Testing Tasks

9.1 CPS Web Application Testing Tasks

Table 7.9.1 Test Suite #1 [SR 3.1.1 Home]

Test #	Description	Expected Outcome	Actual Outcome
TS1.1	Using your favorite browser hit the CPS web app at http://home.nabi.us/CpsWeb/	The main home page should be loaded successfully without any error.	
TS1.2	Click on each hyper links located on top navigation bar of the main Home page	All links should render page without any errors.	
TS 1.3	Click on Crop Profitability Simulator image.	It will bring up Simulator application without any error.	

Table 7.9.1 Test Suite #2 [SR 3.1.2 FAQ]

Test #	Description	Expected Outcome	Actual Outcome
TS2.1	Clink on ‘FAQ’ link located on the top navigation bar.	FAQ page should be loaded without any error.	
TS2.2	Click on each questions of FAQ page.	It should render the answer of the question you have just clicked.	

Table 7.9.3 Test Suite #3 [SR 3.1.3 Contact Us]

Test #	Description	Expected Outcome	Actual Outcome
TS3.1	Clink on ‘Contact Us’ link located on the top navigation bar.	The Contact Us page should be loaded with contact information which should include phone, email, name and physical address.	
TS3.2	Click on the email link given in the contact us page.	It should automatically load your default email client populated email address in « To » field.	

Table 7.9.4 Test Suite #4 [SR 3.1.4 About CPS]

Test #	Description	Expected Outcome	Actual Outcome
TS4.1	Clink on ‘About CPS’ link located on the top navigation bar.	The About CPS page should be loaded without any error. The information should contain name of the product, version and copy write information.	

Table 7.9.5 Test Suite #5 [Covers from SR 3.1.5.1 to SR 3.1.5.4]

Test #	Description	Expected Outcome	Actual Outcome
TS5.1	Click on 'Simulator' link located at the top navigation bar.	The simulator should load without any errors.	
TS5.2	In the location of the land drop down list, change region to North West.	Nothing should change at the UI	
TS5.3	Click on the icon next to location of the land drop drown.	Greater Kansas map should be displayed.	
TS5.4	Click on 'X' hyperlink located on the top right corner of the popup window just opened in TS5.3	Popup window should be closed.	
TS5.5	In Plan1 tab, select number of Crop that you would like to configure for your plan.	Based on your selected value, page should be updated with Crop, Crop System, Land Type and Total area for each crop with default value populated. A summary table should also be displayed on the right along with « Expected Variation » table on the top.	
TS5.6	In the Crop drop down, change selected default Crop to something else. In addition to changing crop, you may also change other values like Crop System,	When the crop or crop system or land type or total acres changes, information of the summary table should be update instantaneously.	

	Land Type and Total Acres, if you like.		
TS 5.7	Click on ⊞ icon and change values of either Income or Cost that may be appropriate for your farm.	Clicking on ⊞ icon will display default values of Income and Cost in details. Changing any value should automatically update the summary table instantaneously as well.	
TS5.8	In the « Expected Variation » form, enter any number (e.g. 5) in the yield field and press 'Tab' in your keyboard. Now, click on 'Summary Details' tab.	With the expected variation value given in yield field, you will see graph with highest and lowest points. The return over cost table should have value represented in the graph.	
TS5.9	Click on 'Plan1' tab, clear the yield value you have entered in TS5.8 and hit 'Tab' key in your keyboard. Now, click on 'Summary Details' tab.	Without any value in the expected variation, you should see a horizontal line in the graph. The value of High, Mean and Low should be the same in « Return Over Cost » table.	
TS5.10	In the « Summary Details » tab, click on the icon.	It will bring up your print dialogue and you should be able to print.	
TS5.11	To compare multiple plans side by side, click on 'Plan1' tab, configure your plan. Enter the appropriate expected variation values may be applicable to your estimate. Then, Click on 'Plan2' and configure the way you like.	As you configure multiple plans, you will see that summary table is added/updated all the plans you have configured.	

TS5.12	Assumed that you have configured multiple plans. Click on 'Summary Details' tab.	You will see return over cost with highest and lowest profit (if expected variation is provided) for all plans side by side along with the bar graph.	

9.2 CPS iPhone Application Testing Tasks

Table 7.9.6 Test Suite #6 [Covers SR 3.2.1.1 to SR 3.2.14]

Test #	Description	Expected Outcome	Actual Outcome
TS6.1	Load the CPS iPhone app either via iPhone simulator. Note: Testing machine will need to have internet access to communicate with backend server via web services.	CPS iPhone will be loaded with two plans and summary tab. By default 'Plan One' will be selected listing the entire region available in our database.	
TS6.2	Click on the Summary tab without configuring any plan.	You will see dialogue popup with the following information : Incomplete plan. Please configure at least one plan to view the summary.	
TS6.3	Click on 'Plan One' tab and click on 'North West' region.	Application will load plan one detailed configuration form without any error with some default value for users' convenience.	
TS6.4	Click on the button with down arrow next to Crop.	This should bring up a window where user can select the crop of his plan.	

TS6.5	Click on the button with down arrow next to LandType and Crop System.	User should be able to select the land type and crop system without any error.	
TS6.6	In the expected variation form of plan one, enter some number (e.g. 5) in yield field. Then click on 'Summary' tab. **TIPS:** Regarding closing the number pad, after typing or selecting number from the number pad, you need to hit enter to close the number pad.	You should see « Return Over Cost » table populated with high, low and mean value returned from the backend server via web service.	
TS 6.7	Click on 'Plan Two' tab and configure another crop with the crops system, land type, total acre and expected variation you like. Then click on 'Summary' tab	With the second plan configured, you will see that summary page is updated with the high, low and mean value of the second plan.	
TS6.8	Note down the plan one and plan two configurations you have performed. Do the same configuration using CPS Web application.	Verify that the high, mean and low value in the « Return Over Cost » table in both CPS iPhone application and CPS Web application is the same.	

10 Environmental Needs

10.1 Environmental needs of CPS Web Application

To test the CPS Web application, the web application and the web service need to be deployed on a Windows 2008 server running IIS. If a Windows 2008 server is not available, any other operating system with IIS and .NET frame work 3.5 installed should be fine. Also a database, SQL Server 2008 or SQL Server 2005, is required.

10.2 Environmental Need of CPS iPhone Application

To officially package the iPhone application, we need to pay an IDP (iPhone Developer Program) membership fee $99 to Apple. Since we don’t have the IDP membership, the only official way we can test is by using an iPhone simulator built-in within XCode, the IDE to develop iPhone application. Hence, to test the CPS iPhone application, Leopard (OSX 10.5) or higher is needed with Coacoa framework and Xcode installed. The machine where the iPhone app is deployed, needs to have access to the Windows box where the web service is deployed.

CHAPTER 8 - ASSESMENT EVALUATION

1 Introduction

This chapter provides the results of functional testing of CPS Software and performance testing. The test cases are based on the Test Plan 1.0 document produced in Phase II.

2 Test Results Summary

Table 8.2.1 Test results summary

Software Component	Test Case	Requirements Tested	Results/Comments
CPS Web App	TS-01	SR 3.1.1	Pass
	TS-02	SR 3.1.2	Pass
	TS-03	SR 3.1.3	Pass
	TS-04	SR 3.1.4	Pass
	TS-05	SR 3.1.5.1, SR 3.1.5.2, SR 3.1.5.3, SR 3.1.5.4	Pass
CPS iPhone App	TS-06	SR 3.2.1.1, SR 3.2.1.2, SR 3.2.1.3, SR 3.2.1.4	Pass

3 Detailed Test Results

3.1 Test Results of CPS Web Application

Table 8.3.1 Test Results of Test Suite #1 [TS-01]

Test #	Description	Expected Outcome	Actual Outcome
TS1.1	Using your favorite browser hit the CPS web app at http://home.nabi.us/CpsWeb/	The main home page should be loaded successfully without any error.	Loaded successfully.
TS1.2	Click on each hyper links located on top navigation bar of the main Home page	All links should render page without any errors.	All links were clicked and loaded successfully

TS 1.3	Click on Crop Profitability Simulator image.	It will bring up Simulator application without any error.	Simulator application loaded successfully.

Table 8.3.2 Test Results of Test Suite #2 [TS-02]

Test #	Description	Expected Outcome	Actual Outcome
TS2.1	Clink on 'FAQ' link located on the top navigation bar.	FAQ page should be loaded without any error.	FAQ page is loaded successfully.
TS2.2	Click on each questions of FAQ page.	It should render the answer of the question you have just clicked.	Clicking on the question rendered the answer.

Table 8.3.3 Test Results of Test Suite #3 [TS-03]

Test #	Description	Expected Outcome	Actual Outcome
TS3.1	Clink on 'Contact Us' link located on the top navigation bar.	The Contact Us page should be loaded with contact information which should include phone, email, name and physical address.	'Contact Us' page loaded successfully. It also displayed email, phone and physical address.
TS3.2	Click on the email link given in the contact us page.	It should automatically load your default email client populated email address in « To » field.	It fired up the email client with email address populated on recipient list.

Table 8.3.4 Test Results of Test Suite #4 [TS-04]

Test #	Description	Expected Outcome	Actual Outcome
TS4.1	Clink on ‘About CPS’ link located on the top navigation bar.	The About CPS page should be loaded without any error. The information should contain name of the product, version and copy write information.	Page loaded successfully. It contains product name, version and copy write information.

Table 8.3.5 Test Results of Test Suite #5 [TS-05]

Test #	Description	Expected Outcome	Actual Outcome
TS5.1	Click on ‘Simulator’ link located at the top navigation bar.	The simulator should load without any errors.	Simulator loaded without any error.
TS5.2	In the location of the land drop down list, change region to North West.	Nothing should change at the UI	No change on UI
TS5.3	Click on the icon next to location of the land drop drown.	Greater Kansas map should be displayed.	Kansas state map was displayed.
TS5.4	Click on ‘X’ hyperlink located on the top right corner of the popup window just opened in TS5.3	Popup window should be closed.	Clicking on ‘X’ link closed the popup window.
TS5.5	In Plan1 tab, select number of Crop that you would like to configure for your plan.	Based on your selected value, page should be updated with Crop, Crop System, Land Type and Total area for each crop with default value populated. A summary table	System provided crop configuration form dynamically

		should also be displayed on the right along with « Expected Variation » table on the top.	based on the number of crop is picked. It also displayed the summary table as well with default cost and income data.
TS5.6	In the Crop drop down, change selected default Crop to something else. In addition to changing crop, you may also change other values like Crop System, Land Type and Total Acres, if you like.	When the crop or crop system or land type or total acres changes, information of the summary table should be update instantaneously.	Changed crop, total acres of land, crop system and land type. Summary table was updated instantaneously when values were changed.
TS 5.7	Click on ⊞ icon and change values of either Income or Cost that may be appropriate for your farm.	Clicking on ⊞ icon will display default values of Income and Cost in details. Changing any value should automatically update the summary table instantaneously as well.	When plus icon is clicked, it pull down editable costs and income values. Upon changing costs and income values, it updated the summary table instantaneously.
TS5.8	In the « Expected Variation » form, enter any	With the expected variation value given in yield field, you will see	Entered 5 in expected

	number (e.g. 5) in the yield field and press ‘Tab’ in your keyboard. Now, click on ‘Summary Details’ tab.	graph with highest and lowest points. The return over cost table should have value represented in the graph.	variation form and clicked on ‘Summary Details’ tab. Noticed that graph had highest and lowest point.
TS5.9	Click on ‘Plan1’ tab, clear the yield value you have entered in TS5.8 and hit ‘Tab’ key in your keyboard. Now, click on ‘Summary Details’ tab.	Without any value in the expected variation, you should see a horizontal line in the graph. The value of High, Mean and Low should be the same in « Return Over Cost » table.	Cleared entered value in TS5.8 for “Plan 1”. Clicked on ‘Summary Details’ and verified that graph shows horizontal line without any highest and lowest point.
TS5.10	In the « Summary Details » tab, click on the icon.	It will bring up your print dialogue and you should be able to print.	It fired up print dialogue and able to print successfully.
TS5.11	To compare multiple plans side by side, click on ‘Plan1’ tab, configure your plan. Enter the appropriate expected variation values may be applicable to your estimate. Then, Click on	As you configure multiple plans, you will see that summary table is added/updated all the plans you have configured.	Configured both “Plan 1” and “Plan 2”. Noticed that while configuring plans, summary

	'Plan2' and configure the way you like.		tables were added automatically.
TS5.12	Assumed that you have configured multiple plans. Click on 'Summary Details' tab.	You will see return over cost with highest and lowest profit (if expected variation is provided) for all plans side by side along with the bar graph.	After configuring "Plan 1" and "Plan 2" with expected variation, system display both plans side by side in the graph as well as "Return over Cost" table.

3.2 Test Results of CPS iPhone Application

Table 8.3.6 Test Results of Test Suite #6 [TS-06]

Test #	Description	Expected Outcome	Actual Outcome
TS6.1	Load the CPS iPhone app either via iPhone simulator. Note: Testing machine will need to have access to the machine that has web service installed.	CPS iPhone will be loaded with two plans and summary tab. By default 'Plan One' will be selected listing the entire region available in our database.	CPS iPhone App loaded successfully. It loaded with 2 plans. Default was "Plan 1" which loaded all the regions to pick to configure the plan.
TS6.2	Click on the Summary tab	You will see dialogue popup with	Clicked on the

	without configuring any plan.	the following information : Incomplete plan. Please configure at least one plan to view the summary.	'Summary' tab and system gave warning "Please configure at least one plan to view the summary".
TS6.3	Click on 'Plan One' tab and click on 'North West' region.	Application will load plan one detailed configuration form without any error with some default value for users' convenience.	Clicked on 'Plan One' and then clicked on 'North West' region. System displayed the detailed plan configuration page.
TS6.4	Click on the button with down arrow next to Crop.	This should bring up a window where user can select the crop of his plan.	Clicking on 'Down Arrow' displayed the list of crops. Able to select the crop by clicking the 'OK' button.
TS6.5	Click on the button with down arrow next to LandType and Crop System.	User should be able to select the land type and crop system without any error.	Able to select or change Crop System and Land Type using the down arrow button as well without any error.
TS6.6	In the expected variation	You should see « Return Over	Entered 5 in the

	form of plan one, enter some number (e.g. 5) in yield field. Then click on 'Summary' tab. **TIPS:** Regarding closing the number pad, after typing or selecting number from the number pad, you need to hit enter to close the number pad.	Cost » table populated with high, low and mean value returned from the backend server via web service.	yield field and click on the summary. Noticed that it displayed the High and Low value in the "Return Over Cost" table in Summary tab.
TS 6.7	Click on 'Plan Two' tab and configure another crop with the crops system, land type, total acre and expected variation you like. Then click on 'Summary' tab	With the second plan configured, you will see that summary page is updated with the high, low and mean value of the second plan.	Plan Two configured. Clicked on the Summary and verified that "Return Over Cost" was updated automatically for newly configured Plan Two.
TS6.8	Note down the plan one and plan two configurations you have performed. Do the same configuration using CPS Web application.	Verify that the high, mean and low value in the « Return Over Cost » table in both CPS iPhone application and CPS Web application is the same.	Verified that data in the "Return Over Cost" is identical for both web and iPhone app.

4 Performance Testing

To produce a quality product, it is imperative to execute performance testing in order to determine speed, scalability, and/or stability characteristic of the system. In performance testing we mostly concentrate on response times, throughput, and resource level utilization. The performance testing helps to identify bottlenecks in the system, establish a baseline for future testing, support performance tuning efforts, and determine compliance with performance goals and requirements. In this scenario, the tool "Jakarta Jmeter" is used to do the performance testing, especially the load testing of the system for two components – web services and web pages and compare the response time.

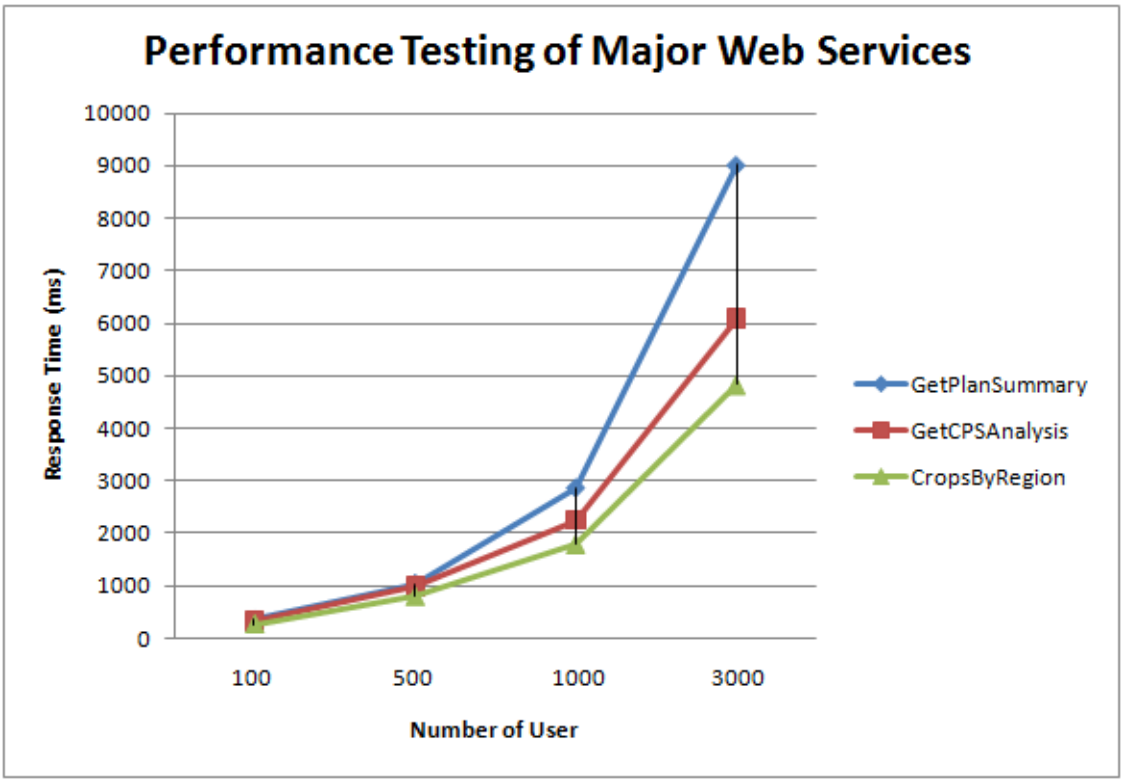
4.1 Response Time Comparison of Web Services

The service oriented CPS Software communicates with database via DALC and BLLC via web services. Below is the comparison of three major web services along with observation notes.

Table 8.4.1 Response times by number of user for major web services

Number of Users	GetPlanSummary	GetCPSAnalysis	CropsByRegion
100	347	327	264
500	1042	986	791
1000	2866	2252	6093
3000	9018	6093	4828

Figure 8.4.1 Performance testing graph of CPS Web Services



Observation: We have captured response times of major web services for 100, 500, 1000 and 3000 users with 1 loop count and 5 ramp-up periods. Since GetCpsPlanSummary web service does some extra computation to display calculated summary, hence, it takes little more time which makes sense. With 1 loop count (more loop count will bring the response time even lower due to caching) and 3000 users, the highest response time is less than 1 sec which is very much acceptable. I wanted to take some more sample with users like 6000, 10000 etc, but due to the limitation of Jmeter, anytime I picked more than 3000 user, Jmeter was throwing java exception. The above stats was taken from home workstation which has very limited resources, couple of years old machine with 2 GB RAM. Deployment of web service to a production level server, response time will decrease significantly.

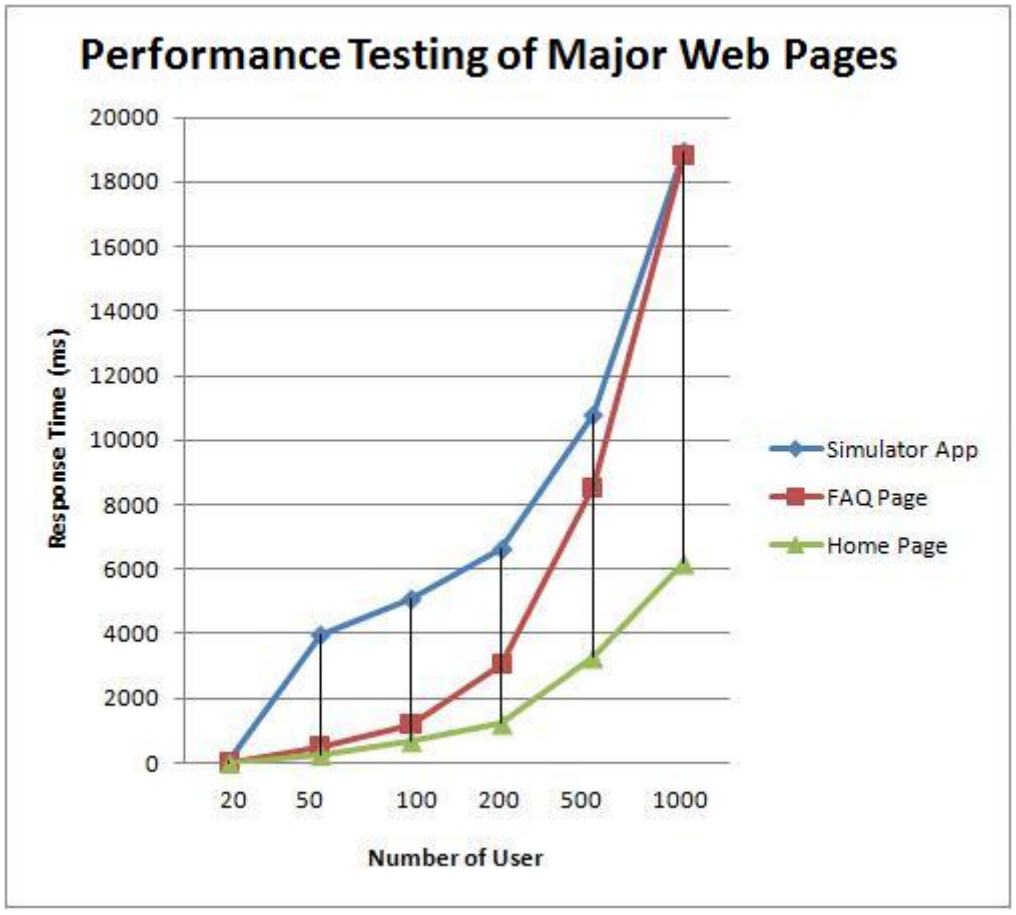
4.2 Response Time Comparison of Major Web Pages

This section compares response times of main CPS Web app (Simulator.aspx) and two other major web pages which are FAQ and Home followed by observation note. All test cases used 5 loop count and 5 second ramp-up period.

Table 8.4.2 Response times by number of user for major web pages

Number of Users	Simulator App	FAQ Page	Home Page
20	45	18	3
50	3958	499	265
100	5070	1197	678
200	6617	3058	1215
500	10766	8544	3265
1000	1893	18823	6179

Figure 8.4.2 Performance testing graph of major CPS Web Pages



Observation: We have captured response times of major web pages for 20, 50, 100, 200, 500 and 1000 users with 5 loop count and 5 second ramp-up periods. Simulator app is the main CPS web application which loads all the required data when first time page loads. This helps to do client side computing for the subsequent request. The size of Simulator page is

almost 49KB, which is pretty good size. This is why for 1000 users with 5 secs ramp-up, response time is around 18 secs. The above stats was taken from home workstation which has very limited resources, couple of years old machine with 2 GB RAM. Deployment of CPS web application to a production level server and having a dedicated DB server, can surely bring the response time down to less than 10 secs for 1000 users. Notice that response time of FAQ page is higher than Home page. This is because of the size of the FAQ page which is 28KB with all questions, answers along with lots of images.

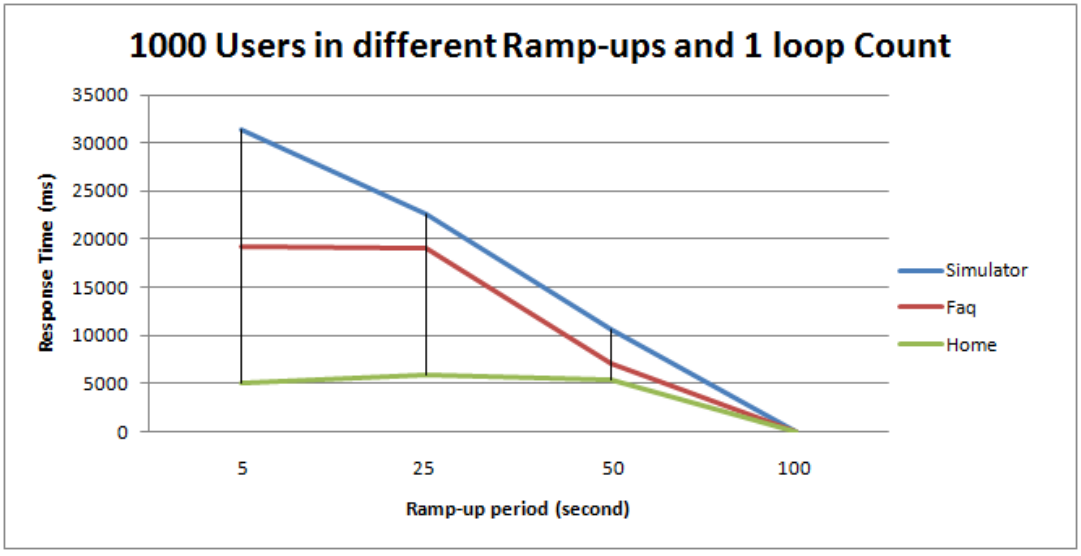
4.3 Comparison of Response Time of 1000 users with different ramp-ups

This section provides comparison of response times of having 1000 users using the system with different ramp-ups. The main goal of this test is to verify for 1000 users what would be limit of ramp-ups to have an acceptable response time.

Table 8.4.3 Response times by ramp-up period with 1000 user for major web pages

Ramp-up Periods	Simulator App	FAQ Page	Home Page
5	31371	19173	5043
25	22602	19107	5913
50	10653	7083	5360
100	47	18	2

Figure 8.4.3 Performance graph with various ramp-ups for 1000 user



Observation: As per the result of the above test, if 1000 users access the system within 50 secs (less than 1 min), response time becomes 5 sec with my low-end machine. If 1000 users access the system within 100 secs (less than 2 mins), response time is very low, which is great. This tells us that for sudden burst of having 1000 new user within a minute, system should be able handle it very gracefully, response time with 5 sec even with poor machine like the developer's. With a production level server and having a dedicated DB server, can surely bring the response time down to 1 or 2 secs.

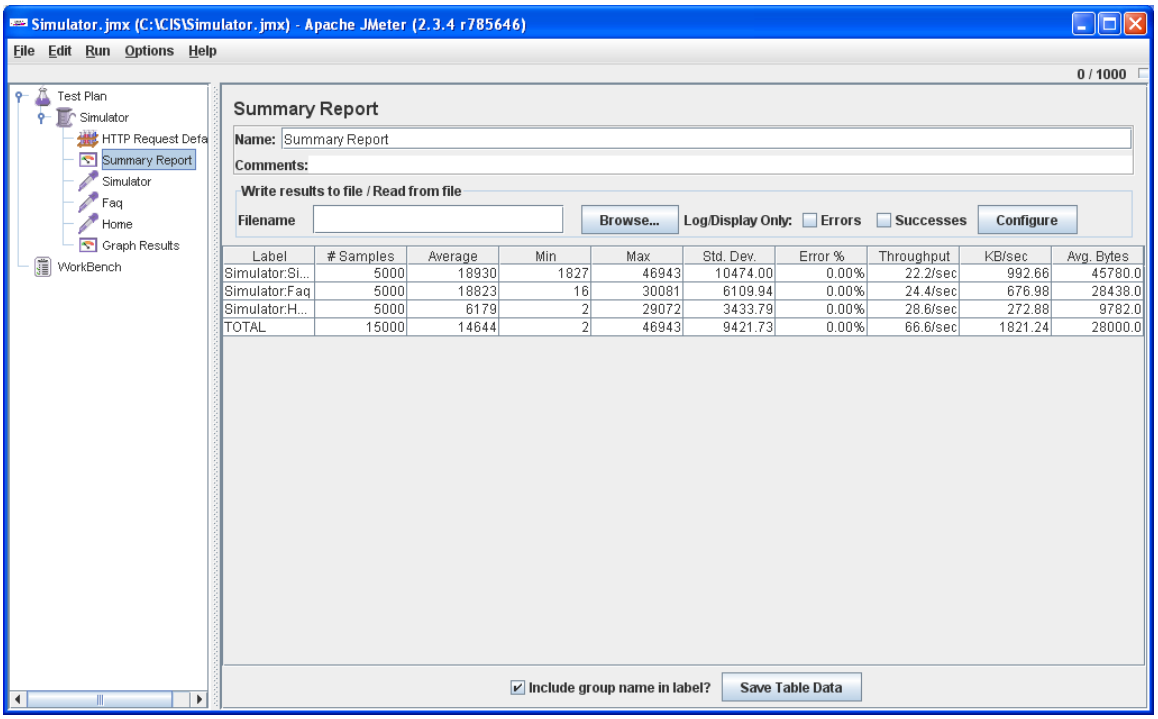
4.4 Throughput of 1000 users with 5 loop count and 5 sec ramp-up

This section displays graph result along with summary table of a test ran with 1000 user, 5 loop count and 5 sec ramp-up period which is also plotted in the section 4.1 graph (Performance testing with major web pages).

The throughput found in this test, **3996/min** supports earlier finding in section 4.3 where we concluded that the CPS Software should have no problem entertaining sudden burst of couple thousand users within 1 to 2 minutes (i.e. 60 to 120 ramp-up secs).

Figure 8.4.4 Graph results of 1000 users with 5 loop count and 5 secs ramp-up

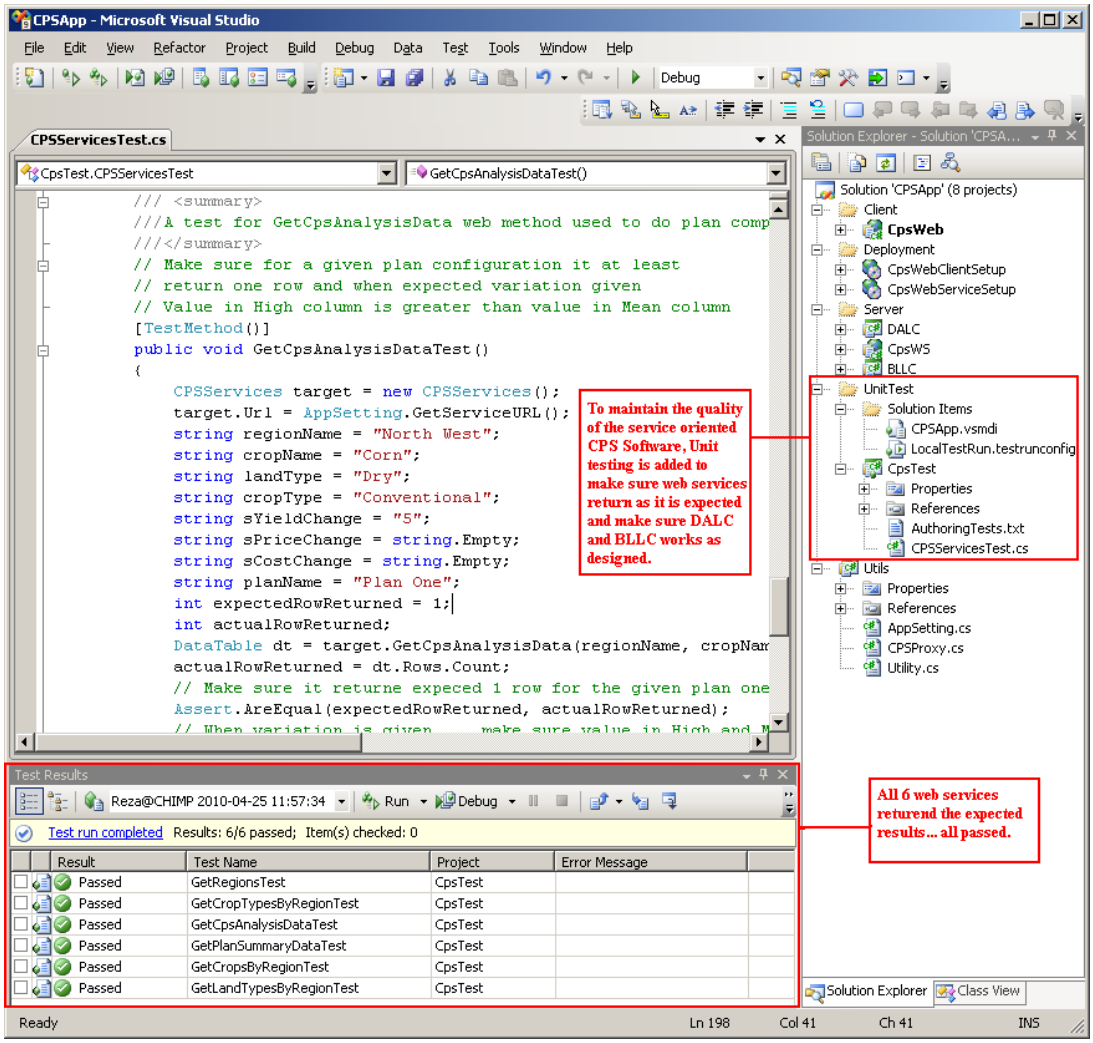
Figure 8.4.5 Summary Report of 1000 users with 5 loop count and 5 secs ramp-up


Simulator.jmx (C:\CIS\Simulator.jmx) - Apache JMeter (2.3.4 r785646)
File Edit Run Options Help
0 / 1000
Test Plan
Simulator
HTTP Request Defa
Summary Report
Simulator
Faq
Home
Graph Results
WorkBench
Summary Report
Name: Summary Report
Comments:
Write results to file / Read from file
Filename
Browse...
Log/Display Only: Errors Successes
Configure
Label # Samples Average Min Max Std. Dev. Error % Throughput KB/sec Avg. Bytes
Simulator:Si... 5000 18930 1827 46943 10474.00 0.00% 22.2/sec 992.66 45780.0
Simulator:Faq 5000 18823 16 30081 6109.94 0.00% 24.4/sec 676.98 28438.0
Simulator:H... 5000 6179 2 29072 3433.79 0.00% 28.6/sec 272.88 9782.0
TOTAL 15000 14644 2 46943 9421.73 0.00% 66.6/sec 1821.24 28000.0
Include group name in label?
Save Table Data

Overall Observation: With the above 4 scenarios, it is clear that with the current architecture and having the system deployed in mid-end machine, software should be able to handle 1000 (one thousand) users very easily. With having CPS Software deployed in good production level machine with dedicated DB server, it can certainly entertain sudden burst of couple of thousands users within 1 to 2 mins of time without any difficulty.

5 Unit Testing

In an effort to maintain the quality of the code as well as to maintain the quality of the Service Oriented CPS Software, unit tests were added to the source code and tested by the developer. The scope of the unit tests were limited to the Web Service Component only. Since the framework for unit testing is already in place adding unit tests for other components should be very easy and straight forward. Below is the screenshot of the result of the unit tests of all web services.


CPSApp - Microsoft Visual Studio
File Edit View Refactor Project Build Debug Data Test Tools Window Help
Debug
CPSServicesTest.cs
CpsTest.CPSServicesTest
GetCpsAnalysisDataTest()
/// <summary>
///A test for GetCpsAnalysisData web method used to do plan comp
///</summary>
// Make sure for a given plan configuration it at least
// return one row and when expected variation given
// Value in High column is greater than value in Mean column
[TestMethod()]
public void GetCpsAnalysisDataTest()
{
CPSServices target = new CPSServices();
target.Url = AppSetting.GetServiceURL();
string regionName = "North West";
string cropName = "Corn";
string landType = "Dry";
string cropType = "Conventional";
string sYieldChange = "5";
string sPriceChange = string.Empty;
string sCostChange = string.Empty;
string planName = "Plan One";
int expectedRowReturned = 1;
int actualRowReturned;
DataTable dt = target.GetCpsAnalysisData(regionName, cropNam
actualRowReturned = dt.Rows.Count;
// Make sure it returne expeced 1 row for the given plan one
Assert.AreEqual(expectedRowReturned, actualRowReturned);
To maintain the quality of the service oriented CPS Software, Unit testing is added to make sure web services return as it is expected and make sure DALC and BLLC works as designed.
Solution Explorer - Solution 'CPSA...
Solution 'CPSApp' (8 projects)
Client
CpsWeb
Deployment
CpsWebClientSetup
CpsWebServiceSetup
Server
DALC
CpsWS
BLLC
UnitTest
Solution Items
CPSApp.vsmdi
LocalTestRun.testrunconfig
CpsTest
Properties
References
AuthoringTests.txt
CPSServicesTest.cs
Utils
Properties
References
AppSetting.cs
CPSProxy.cs
Utility.cs
Test Results
Reza@CHIMP 2010-04-25 11:57:34
Run
Debug
Test run completed Results: 6/6 passed; Item(s) checked: 0
Result Test Name Project Error Message
Passed GetRegionsTest CpsTest
Passed GetCropTypesByRegionTest CpsTest
Passed GetCpsAnalysisDataTest CpsTest
Passed GetPlanSummaryDataTest CpsTest
Passed GetCropsByRegionTest CpsTest
Passed GetLandTypesByRegionTest CpsTest
All 6 web services returend the expected results... all passed.
Solution Explorer
Class View
Ready
Ln 198
Col 41
Ch 41
INS

CHAPTER 9 - USER MANUAL

1 Introduction

The Whole Farm CPS Software allows farmers in Kansas and surrounding states to assess market risks for multiple farming plans, including conventional and organic farming methods.

In addition to the default values based on Kansas Farm Management Guides, the Simulator allows you to customize your calculations to your individual situations in terms of specific revenue and cost items and possible variability in price, yield, and cost. The whole farm profitability for multiple plans will be summarized in tabular format (and Graph for web client) for easy comparison. Detailed feature is available in section 3, Software Operation.

Figure 9.1.1 CPS Software Highlights

2 Software Installation

This section provides required hardware, software and installation process of CPS Software.

2.1 Required Hardware

- **DB Server:** Server should be equipped with at least 2.4 GHz CPU clock speed, 2 GB RAM and 120 GB Hard drive.
- **Web Server:** Server should be equipped with at least 2.4 GHz CPU clock speed, 2 GB RAM and 120 GB Hard drive.
- **iPhone Simulator:** Since iPhone client needs to be packaged by Apple Developer Program and we don't have the subscription yet, for now, we need Mac pc or Macbook, to test CPS iPhone client using built-in iPhone simulator in XCode.

NOTE: If client have limited resources, one physical machine with 4GB RAM and 250 GB hard drive playing both DB server and web server role should be sufficient as well.

2.2 Required Software

2.2.1 Required Software CPS Web App

- Microsoft Windows 2008 Server with Web Server role
- MS SQL Server 2008 or MS SQL Server 2005
- CPS Web Client MSI Package, Available online at http://home.nabi.us/CpsWeb/docs/PhaseIII/Setup/CpsWebClientSetup.msi
- CPS Web Service MSI Package, Available online at http://home.nabi.us/CpsWeb/docs/PhaseIII/Setup/CpsWebServiceSetup.msi
- CPS Database Installation Scripts, available online at http://home.nabi.us/CpsWeb/docs/PhaseIII/Setup/DatabaseSetup.zip

2.2.2 Required Software CPS iPhone App

- Mac OS 10.5 or Higher
- Apple iPhone Development Kit 3.0 or Higher
- XCode (IDE)
- CPS iPhone Client, Available online at http://home.nabi.us/CpsWeb/docs/PhaseIII/Setup/iPhoneClient.zip

NOTE: When iPhone application will be packaged by Apple, none of the above software is required. All we need is iPhone or iPod Touch with deployable CPS iPhone Application package.

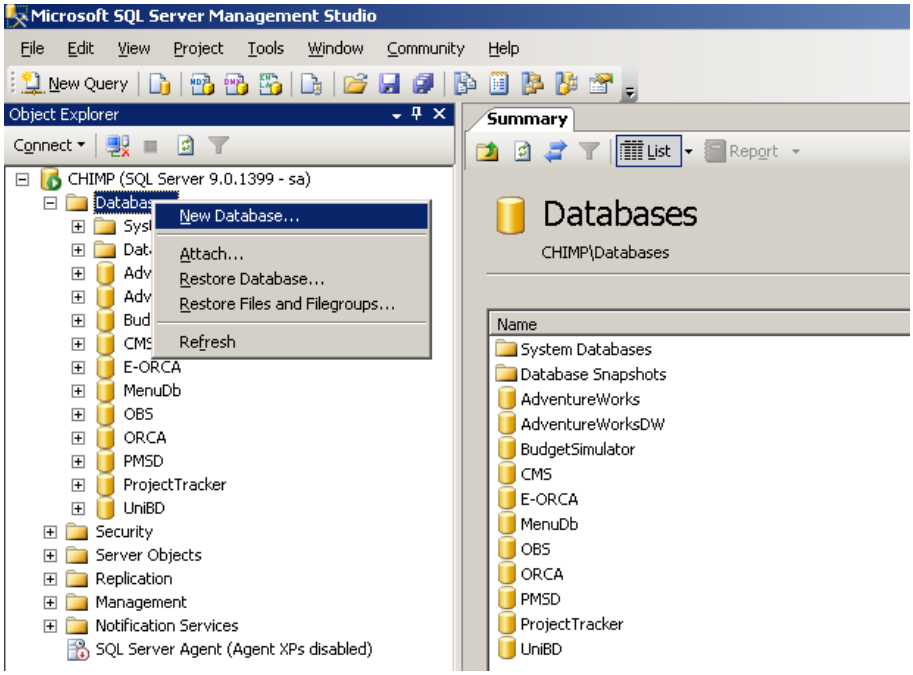
2.3 Install CPS Software and Setup

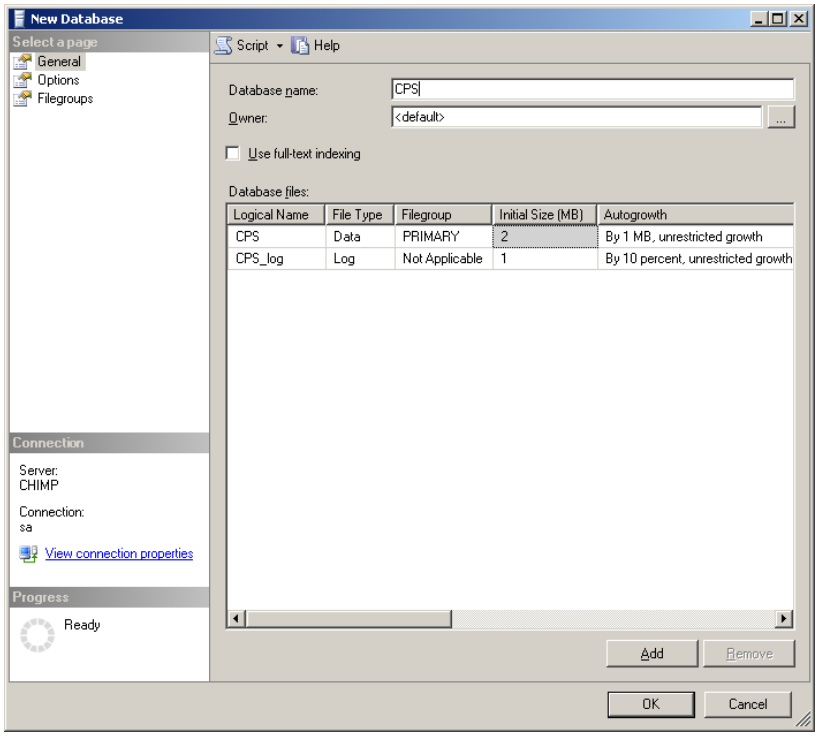
This section provides steps to load the database, setup web client, web service and iPhone application.

2.3.1 Load Database

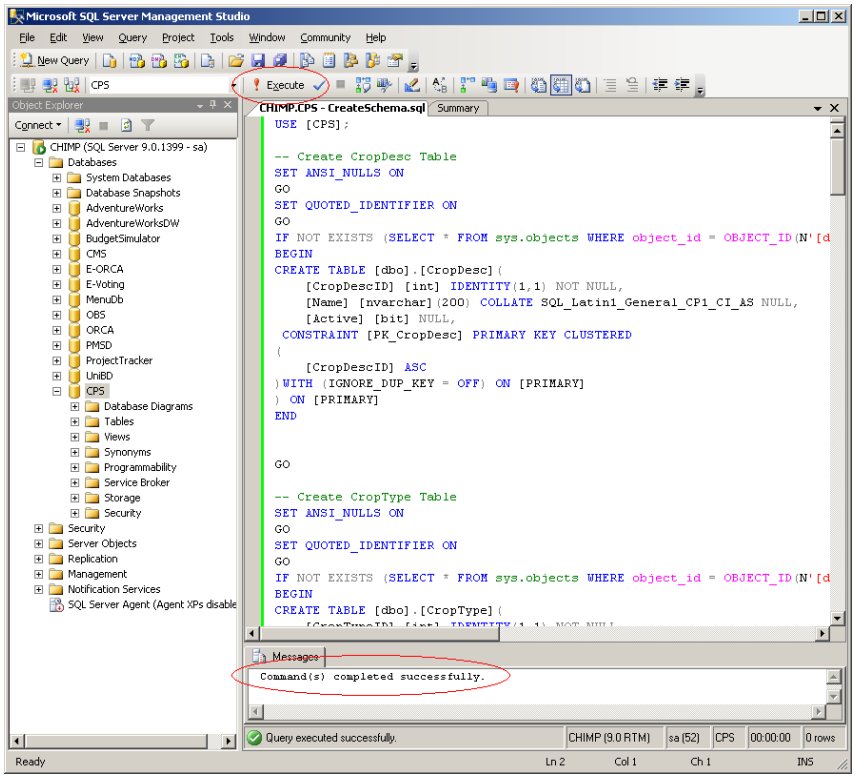
1 Download and unzip the Database Installation scripts available online at http://home.nabi.us/CpsWeb/docs/PhaseIII/Setup/DatabaseSetup.zip

2 Load SQL Server Management Studio and create a database called '**CPS**'.

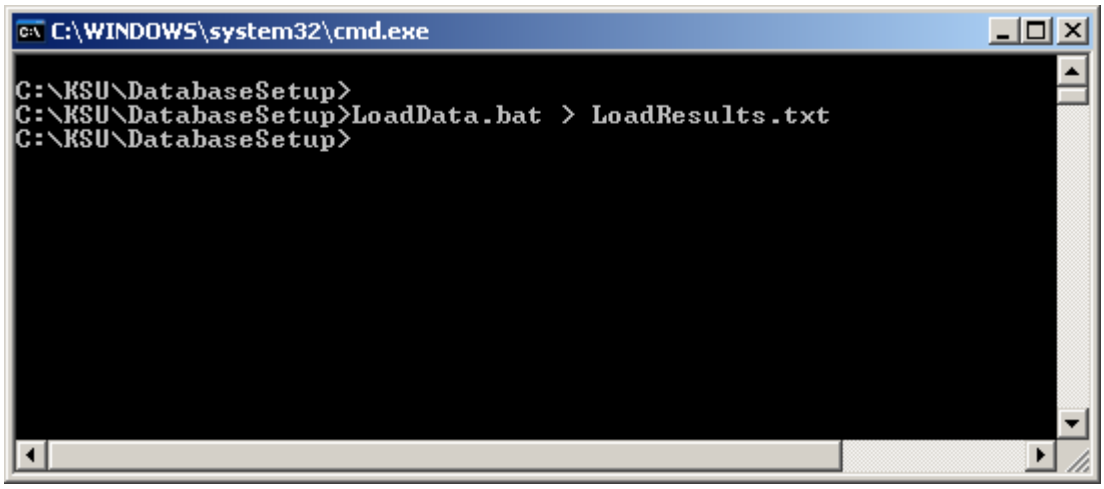




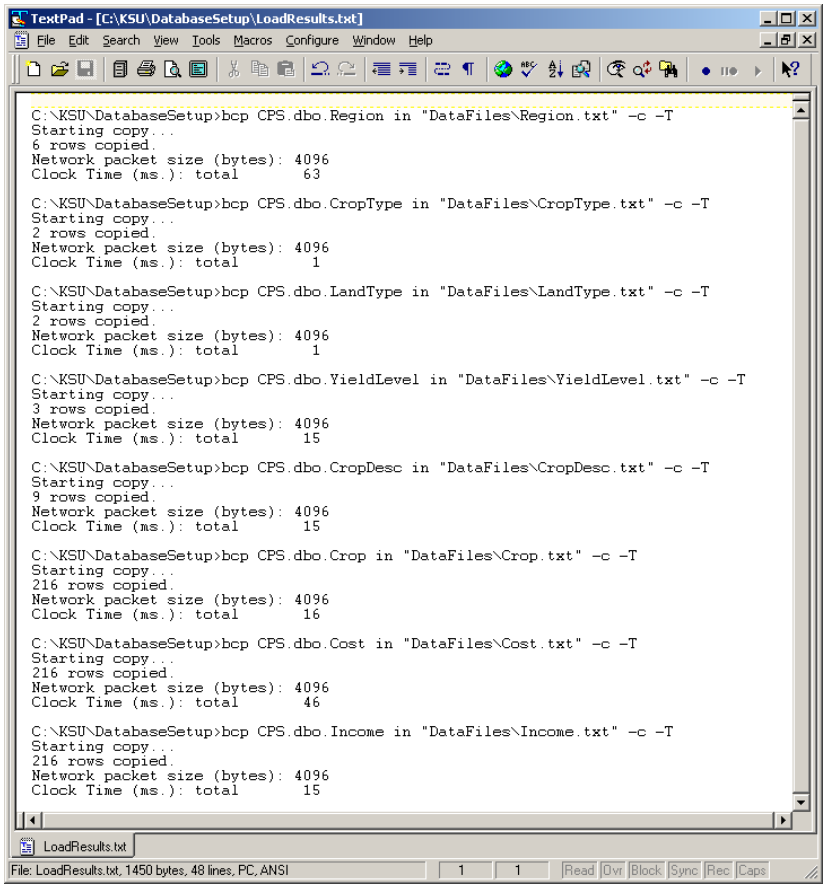
3 Load the CPS Schema by executing CreateSchema.sql which is available under DatabaseSetup folder.



4 Load the CPS data by running LoadData.bat like the following.



5 Verify that there is no error in LoadResults.txt file. Healthy logfile may look like the following.

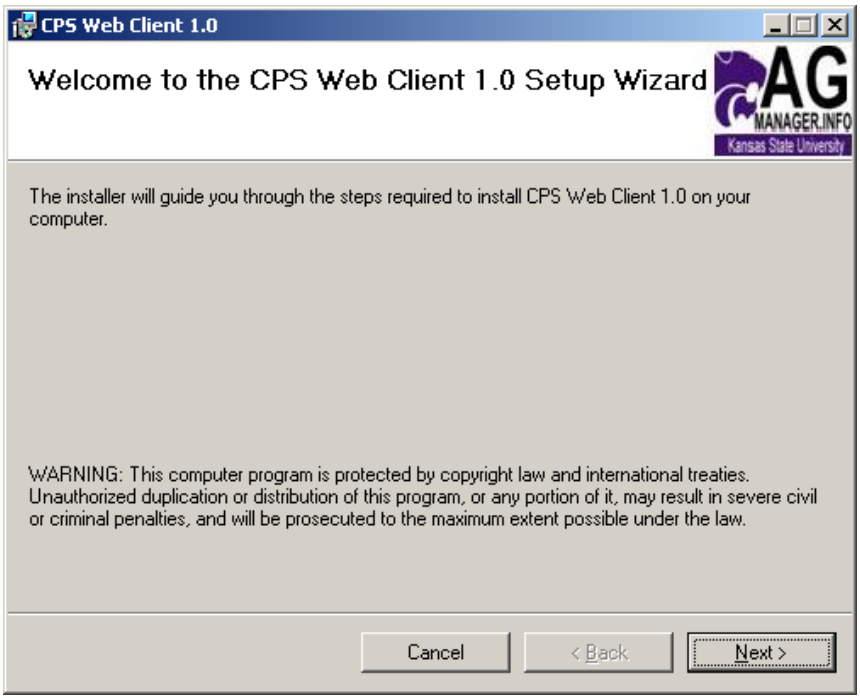

TextPad - [C:\KSU\DatabaseSetup\LoadResults.txt]
File Edit Search View Tools Macros Configure Window Help
C:\KSU\DatabaseSetup>bcp CPS.dbo.Region in "DataFiles\Region.txt" -c -T
Starting copy...
6 rows copied.
Network packet size (bytes): 4096
Clock Time (ms.): total 63
C:\KSU\DatabaseSetup>bcp CPS.dbo.CropType in "DataFiles\CropType.txt" -c -T
Starting copy...
2 rows copied.
Network packet size (bytes): 4096
Clock Time (ms.): total 1
C:\KSU\DatabaseSetup>bcp CPS.dbo.LandType in "DataFiles\LandType.txt" -c -T
Starting copy...
2 rows copied.
Network packet size (bytes): 4096
Clock Time (ms.): total 1
C:\KSU\DatabaseSetup>bcp CPS.dbo.YieldLevel in "DataFiles\YieldLevel.txt" -c -T
Starting copy...
3 rows copied.
Network packet size (bytes): 4096
Clock Time (ms.): total 15
C:\KSU\DatabaseSetup>bcp CPS.dbo.CropDesc in "DataFiles\CropDesc.txt" -c -T
Starting copy...
9 rows copied.
Network packet size (bytes): 4096
Clock Time (ms.): total 15
C:\KSU\DatabaseSetup>bcp CPS.dbo.Crop in "DataFiles\Crop.txt" -c -T
Starting copy...
216 rows copied.
Network packet size (bytes): 4096
Clock Time (ms.): total 16
C:\KSU\DatabaseSetup>bcp CPS.dbo.Cost in "DataFiles\Cost.txt" -c -T
Starting copy...
216 rows copied.
Network packet size (bytes): 4096
Clock Time (ms.): total 46
C:\KSU\DatabaseSetup>bcp CPS.dbo.Income in "DataFiles\Income.txt" -c -T
Starting copy...
216 rows copied.
Network packet size (bytes): 4096
Clock Time (ms.): total 15
LoadResults.txt
File: LoadResults.txt, 1450 bytes, 48 lines, PC, ANSI
Read Ovr Block Sync Rec Caps

2.3.2 Install CPS Web Application

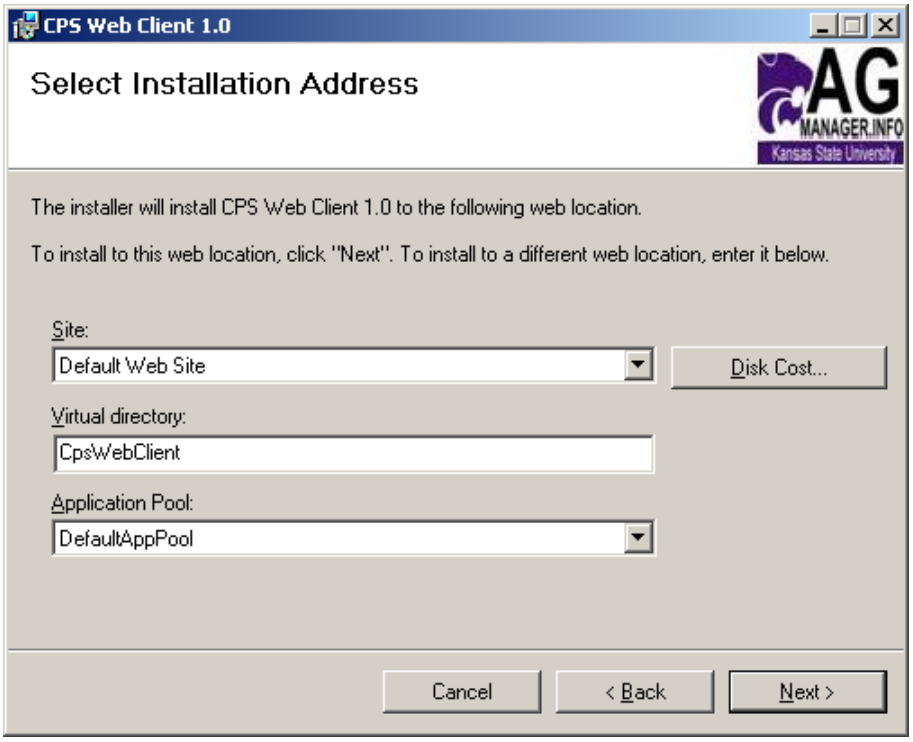
1 Download the CPS Web Client MSI Package, Available online at http://home.nabi.us/CpsWeb/docs/PhaseIII/Setup/CpsWebClientSetup.msi

2 Double-click the CpsWebClientSetup.msi file and load the CPS Web Client 1.0 setup wizard

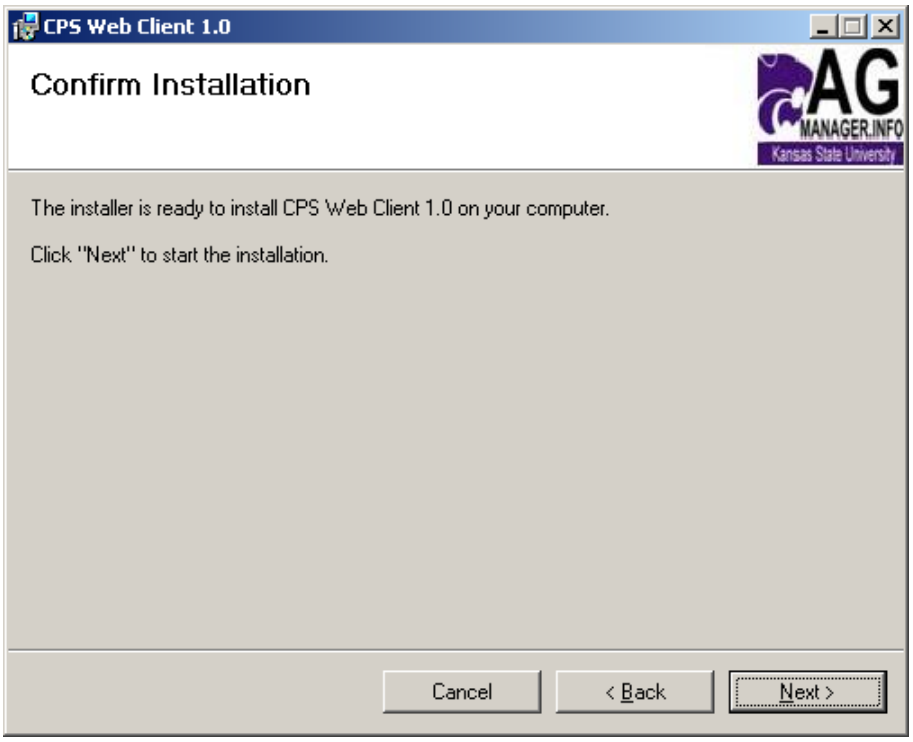
3 Click on 'Next' button to continue

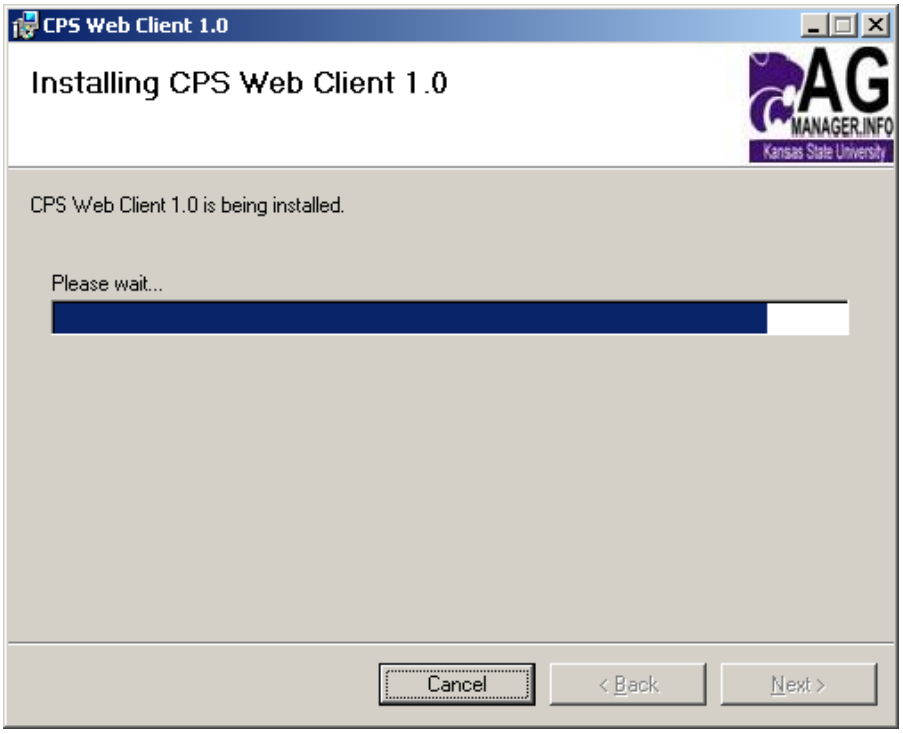

CPS Web Client 1.0
Welcome to the CPS Web Client 1.0 Setup Wizard
AG
MANAGER.INFO
Kansas State University
The installer will guide you through the steps required to install CPS Web Client 1.0 on your computer.
WARNING: This computer program is protected by copyright law and international treaties. Unauthorized duplication or distribution of this program, or any portion of it, may result in severe civil or criminal penalties, and will be prosecuted to the maximum extent possible under the law.
Cancel
< Back
Next >

4 Provide the installation address you like and click 'Next' to continue. By default, **CPSWebClient** is set as virtual directory for the web application. You may change it to any meaningful name you like (e.g. **CPSWeb**).

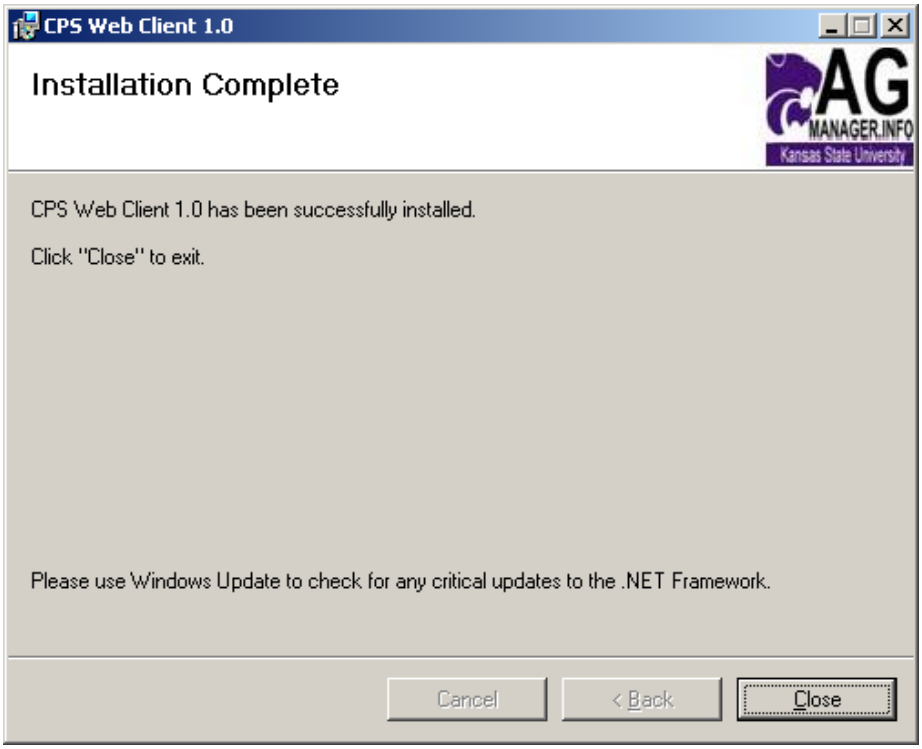


5 Click ‘Next’ to begin installation.





6 CPS Web Application (Client) installation complete. Click on ‘Close’ to exit the setup wizard.

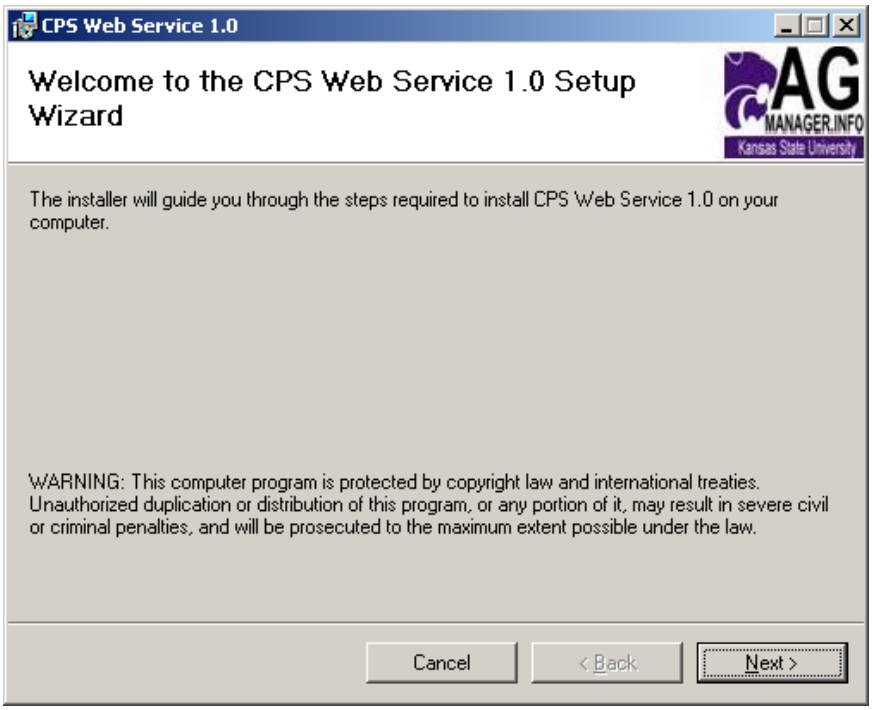


2.3.3 Install CPS Web Service

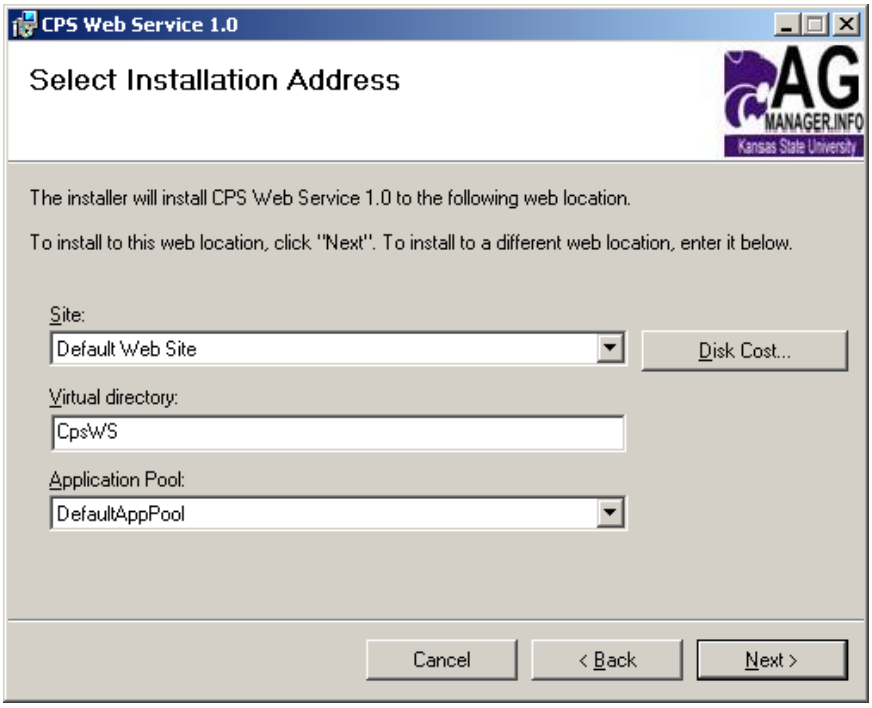
1 Download the CPS Web Service MSI Package, Available online at http://home.nabi.us/CpsWeb/docs/PhaseIII/Setup/CpsWebService.msi

2 Double-click the **CpsWebServiceSetup.msi** file and load the CPS Web Service 1.0 setup wizard

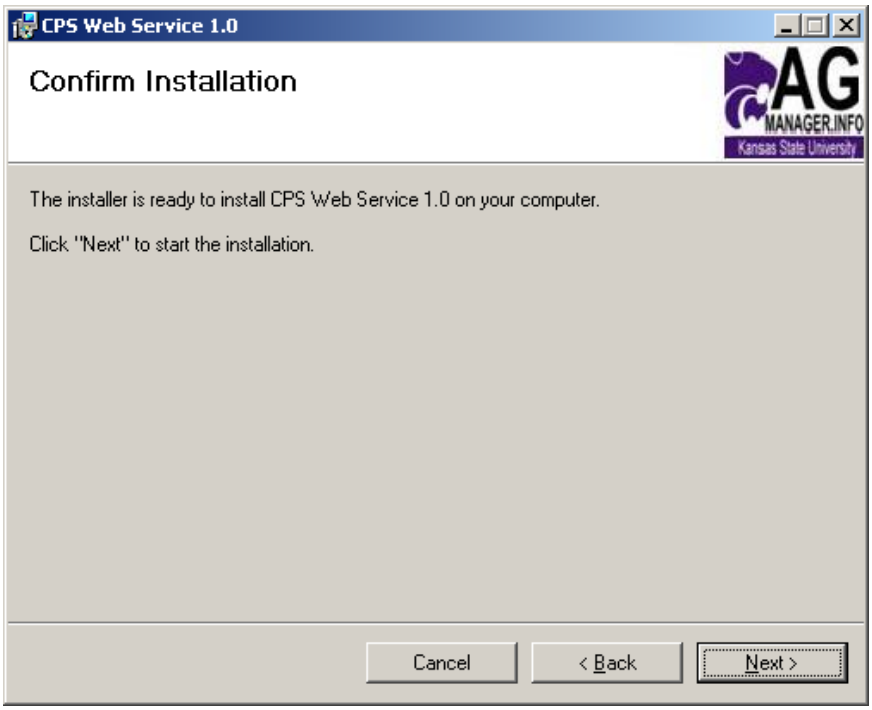
3 Click on 'Next' button to continue

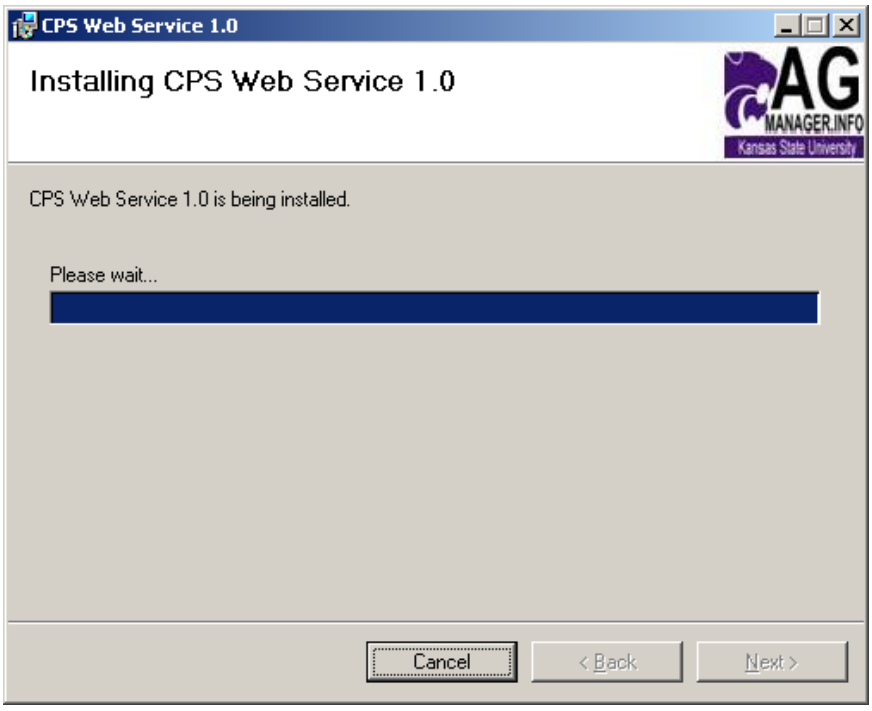

CPS Web Service 1.0
Welcome to the CPS Web Service 1.0 Setup Wizard
AG
MANAGER.INFO
Kansas State University
The installer will guide you through the steps required to install CPS Web Service 1.0 on your computer.
WARNING: This computer program is protected by copyright law and international treaties. Unauthorized duplication or distribution of this program, or any portion of it, may result in severe civil or criminal penalties, and will be prosecuted to the maximum extent possible under the law.
Cancel
< Back
Next >

4 Provide the installation address you like and click 'Next' to continue.

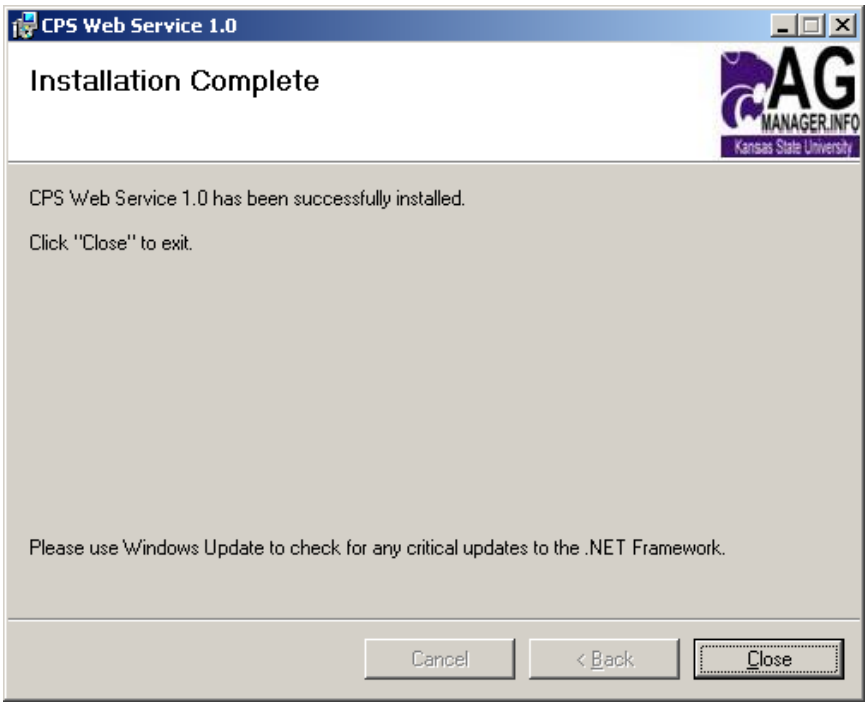


5 Click ‘Next’ to begin installation.





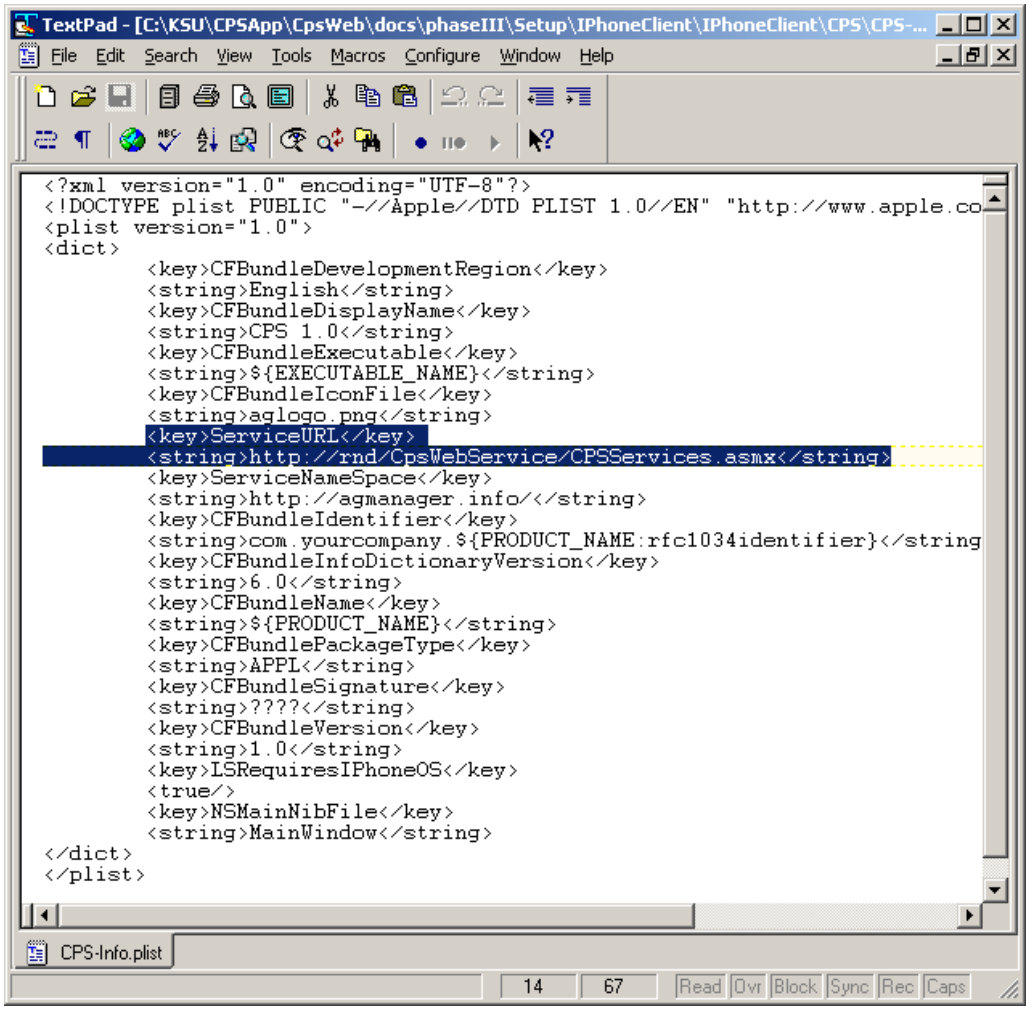
6 CPS Web Service installation is complete. Click on ‘Close’ to exit the setup wizard.



2.3.4 Install CPS iPhone Client

1 Download CPS iPhone Application Source Code, Available online at http://home.nabi.us/CpsWeb/docs/PhaseIII/Setup/iPhoneClient.zip, to MacBook or Mac PC where iPhoneSDK 3.0 (or higher) and XCode is installed.

2 Open up CPS-Info.plist file and make sure SeriveURL is pointed to the correct address where you have installed in section 2.3.3.



3 Double click on CPS project file (**CPS.xcodeproj**) and load the iPhone application on XCode IDE.

4 Click on “Build and Go” to load the CPS iPhone Application using iPhone Simulator.

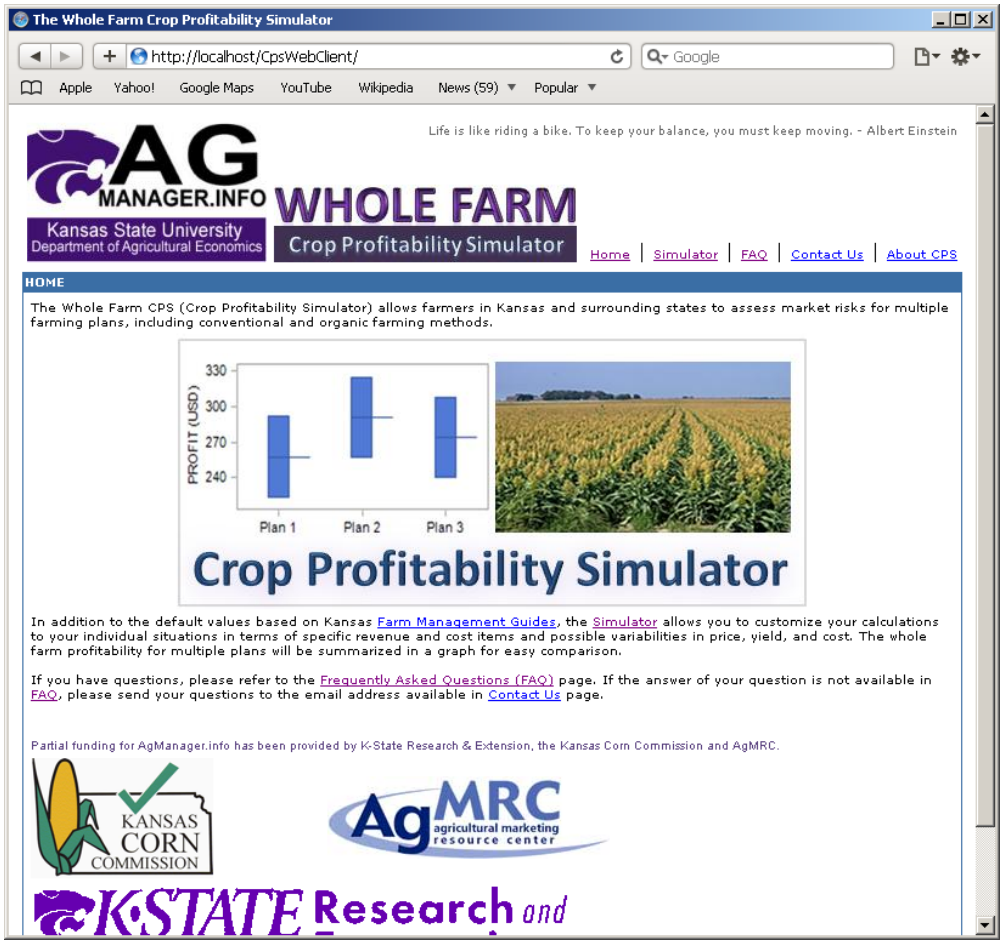
3 CPS Software Operation

This section provides instructions on how to use the CPS Software.

3.1 CPS Web Application Operation

3.1.1 Home (Main Home Page)

Using your favorite browser hit the address where you have installed the CPS Web Application (Client). Developer's CPS Web application (Client) is accessible at http://home.nabi.us/CpsWeb/Default.aspx


The Whole Farm Crop Profitability Simulator
http://localhost/CpsWebClient/
Google
Apple
Yahoo!
Google Maps
YouTube
Wikipedia
News (59)
Popular
Life is like riding a bike. To keep your balance, you must keep moving. - Albert Einstein
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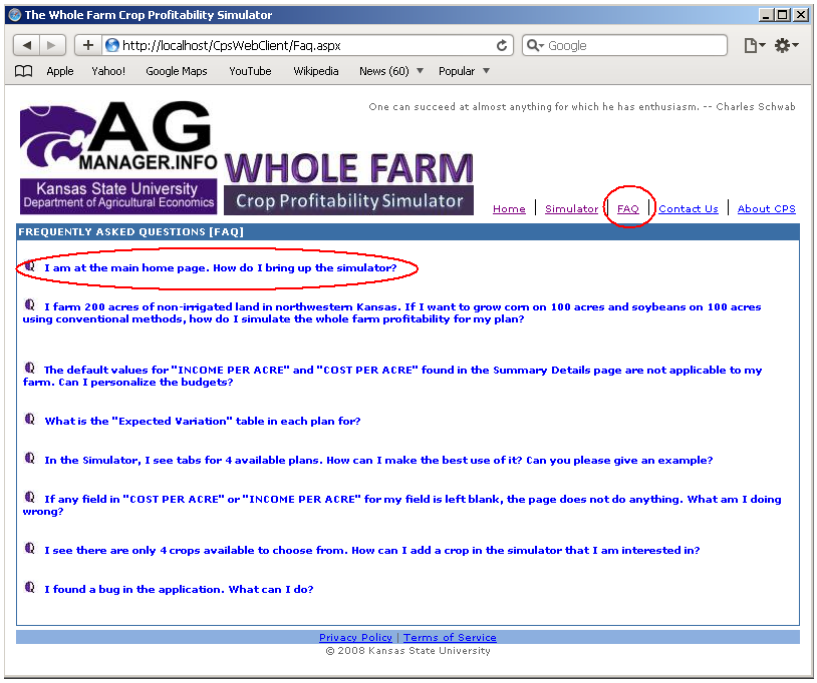
WHOLE FARM
Crop Profitability Simulator
Home | Simulator | FAQ | Contact Us | About CPS
HOME
The Whole Farm CPS (Crop Profitability Simulator) allows farmers in Kansas and surrounding states to assess market risks for multiple farming plans, including conventional and organic farming methods.
330
300
270
240
PROFIT (USD)
Plan 1
Plan 2
Plan 3
Crop Profitability Simulator
In addition to the default values based on Kansas Farm Management Guides, the Simulator allows you to customize your calculations to your individual situations in terms of specific revenue and cost items and possible variabilities in price, yield, and cost. The whole farm profitability for multiple plans will be summarized in a graph for easy comparison.
If you have questions, please refer to the Frequently Asked Questions (FAQ) page. If the answer of your question is not available in FAQ, please send your questions to the email address available in Contact Us page.
Partial funding for AgManager.info has been provided by K-State Research & Extension, the Kansas Corn Commission and AgMRC.
KANSAS CORN COMMISSION
AgMRC agricultural marketing resource center
K-STATE Research and

3.1.2 FAQ

From the main home, click on 'FAQ' hyper link, to load FAQ page. Click on question to view the answer of the question.


The Whole Farm Crop Profitability Simulator
http://localhost/CpsWebClient/Faq.aspx
Apple Yahoo! Google Maps YouTube Wikipedia News (60) Popular
One can succeed at almost anything for which he has enthusiasm. -- Charles Schwab
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Kansas State University Department of Agricultural Economics
WHOLE FARM
Crop Profitability Simulator
Home | Simulator | FAQ | Contact Us | About CPS
FREQUENTLY ASKED QUESTIONS [FAQ]
I am at the main home page. How do I bring up the simulator?
I farm 200 acres of non-irrigated land in northwestern Kansas. If I want to grow corn on 100 acres and soybeans on 100 acres using conventional methods, how do I simulate the whole farm profitability for my plan?
The default values for "INCOME PER ACRE" and "COST PER ACRE" found in the Summary Details page are not applicable to my farm. Can I personalize the budgets?
What is the "Expected Variation" table in each plan for?
In the Simulator, I see tabs for 4 available plans. How can I make the best use of it? Can you please give an example?
If any field in "COST PER ACRE" or "INCOME PER ACRE" for my field is left blank, the page does not do anything. What am I doing wrong?
I see there are only 4 crops available to choose from. How can I add a crop in the simulator that I am interested in?
I found a bug in the application. What can I do?
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The Whole Farm Crop Profitability Simulator
http://localhost/CpsWebClient/Faq.aspx
Apple Yahoo! Google Maps YouTube Wikipedia News (60) Popular
One can succeed at almost anything for which he has enthusiasm. -- Charles Schwab
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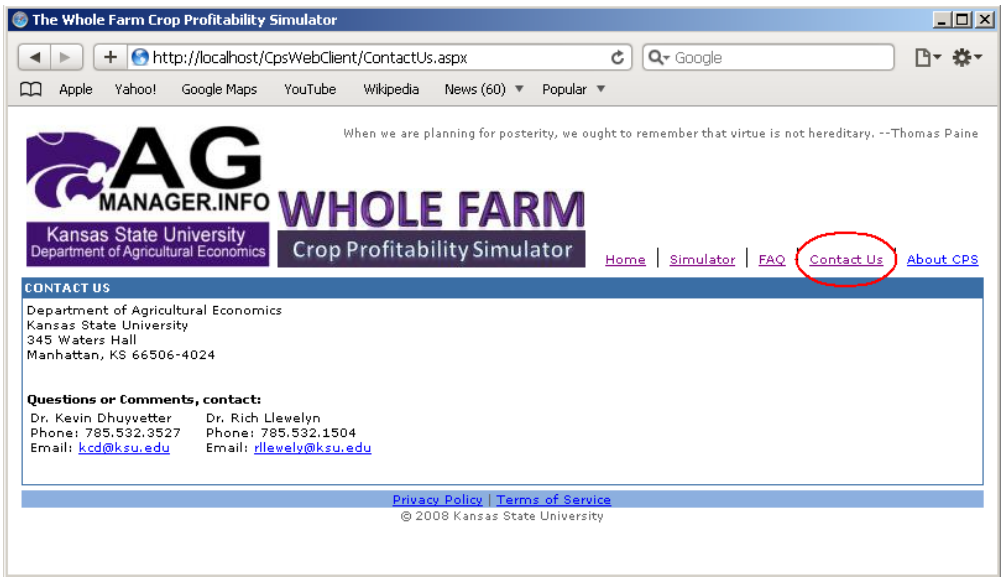
Crop Profitability Simulator
Home | Simulator | FAQ | Contact Us | About CPS
FREQUENTLY ASKED QUESTIONS [FAQ]
I am at the main home page. How do I bring up the simulator?
Click on the 'Simulator' hyperlink on the top navigation bar. You can also bring up the simulator by clicking on 'Crop Profitability Simulator' image.
Department of Agricultural Economics
Crop Profitability Simulator
Home | Simulator | FAQ | Contact Us | About CPS
HOME
The Whole Farm CPS (Crop Profitability Simulator) allows farmers in Kansas and surrounding states to assess market risks for multiple farming plans, including conventional and organic farming methods.
330
300
270
240
PROFIT (USD)
Plan 1
Plan 2
Plan 3
Crop Profitability Simulator
In addition to the default values based on Kansas Farm Management Guides, the Simulator allows you to customize your calculations to your individual situations in terms of specific revenue and cost items and possible variabilities in price, yield, and cost. The whole farm profitability for multiple plans will be summarized in a graph for easy comparison.
If you have questions, please refer to the Frequently Asked Questions (FAQ) page. If the answer of your question is not available in FAQ, please send your questions to the email address available in Contact Us page.
I farm 200 acres of non-irrigated land in northwestern Kansas. If I want to grow corn on 100 acres and soybeans on 100 acres using conventional methods, how do I simulate the whole farm profitability for my plan?

3.1.3 Contact Us

Click on ‘Contact us’, link view the contacts of general questions or comments.



3.1.4 About CPS

Click on 'About CPS' link to view the name of the product, version and copyright information.

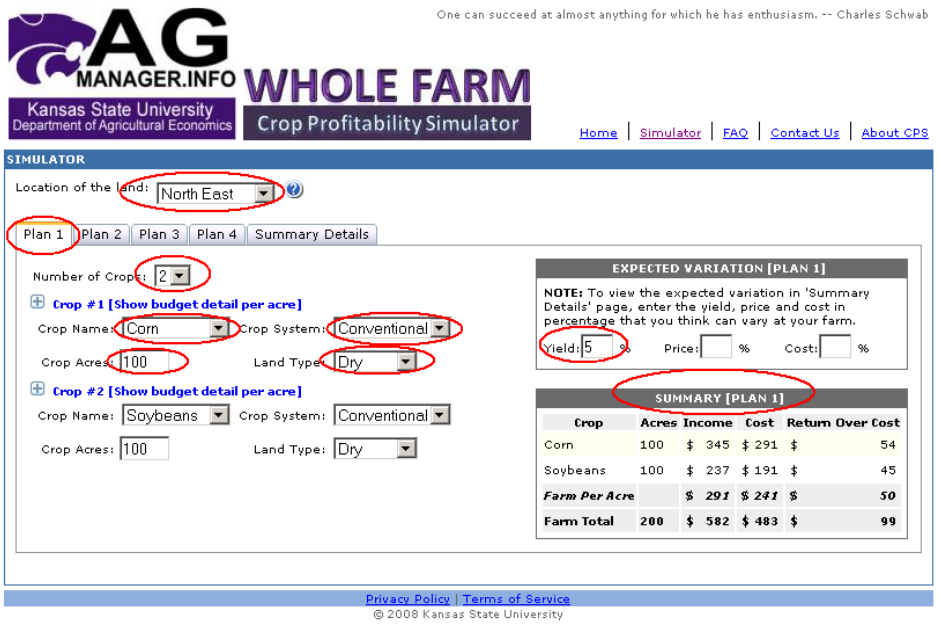
3.1.5 Simulator

Click on 'Simulator' link to bring up the main Crop Profitability Simulator [CPS] application.

3.1.5.1 Configure a Plan

Configuring a plan is a 4 step process:

- Select location of the land.
- Select how many crops you would like to include in this plan
- Enter Crop, Crop System, Land Type and Crop Acre for each crop
- Enter Expected Variation if you would like to see best and worst scenario of your profit (return over cost).


One can succeed at almost anything for which he has enthusiasm. -- Charles Schwab
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Department of Agricultural Economics
WHOLE FARM
Crop Profitability Simulator
Home | Simulator | FAQ | Contact Us | About CPS
SIMULATOR
Location of the land: North East
Plan 1 Plan 2 Plan 3 Plan 4 Summary Details
Number of Crops: 2
Crop #1 [Show budget detail per acre]
Crop Name: Corn
Crop System: Conventional
Crop Acres: 100
Land Type: Dry
Crop #2 [Show budget detail per acre]
Crop Name: Soybeans
Crop System: Conventional
Crop Acres: 100
Land Type: Dry
EXPECTED VARIATION [PLAN 1]
NOTE: To view the expected variation in 'Summary Details' page, enter the yield, price and cost in percentage that you think can vary at your farm.
Yield: 5 % Price: % Cost: %
SUMMARY [PLAN 1]
Crop Acres Income Cost Return Over Cost
Corn 100 $ 345 $ 291 $ 54
Soybeans 100 $ 237 $ 191 $ 45
Farm Per Acre $ 291 $ 241 $ 50
Farm Total 200 $ 582 $ 483 $ 99
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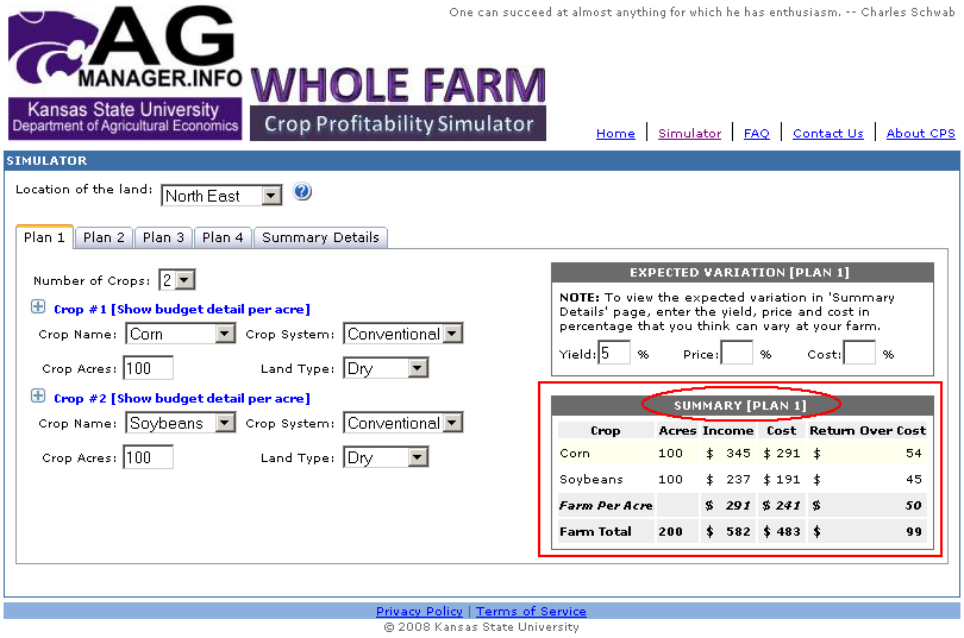
3.1.5.2 View Summary

As user configures a plan, Summary is updated automatically.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WHOLE FARM
Crop Profitability Simulator
Home | Simulator | FAQ | Contact Us | About CPS
SIMULATOR
Location of the land: North East
Plan 1 | Plan 2 | Plan 3 | Plan 4 | Summary Details
Number of Crops: 2
Crop #1 [Show budget detail per acre]
Crop Name: Corn Crop System: Conventional
Crop Acres: 100 Land Type: Dry
Crop #2 [Show budget detail per acre]
Crop Name: Soybeans Crop System: Conventional
Crop Acres: 100 Land Type: Dry
EXPECTED VARIATION [PLAN 1]
NOTE: To view the expected variation in 'Summary Details' page, enter the yield, price and cost in percentage that you think can vary at your farm.
Yield: 5 % Price: % Cost: %
SUMMARY [PLAN 1]
Crop | Acres | Income | Cost | Return Over Cost
Corn | 100 | $ 345 | $ 291 | $ 54
Soybeans | 100 | $ 237 | $ 191 | $ 45
Farm Per Acre | | $ 291 | $ 241 | $ 50
Farm Total | 200 | $ 582 | $ 483 | $ 99
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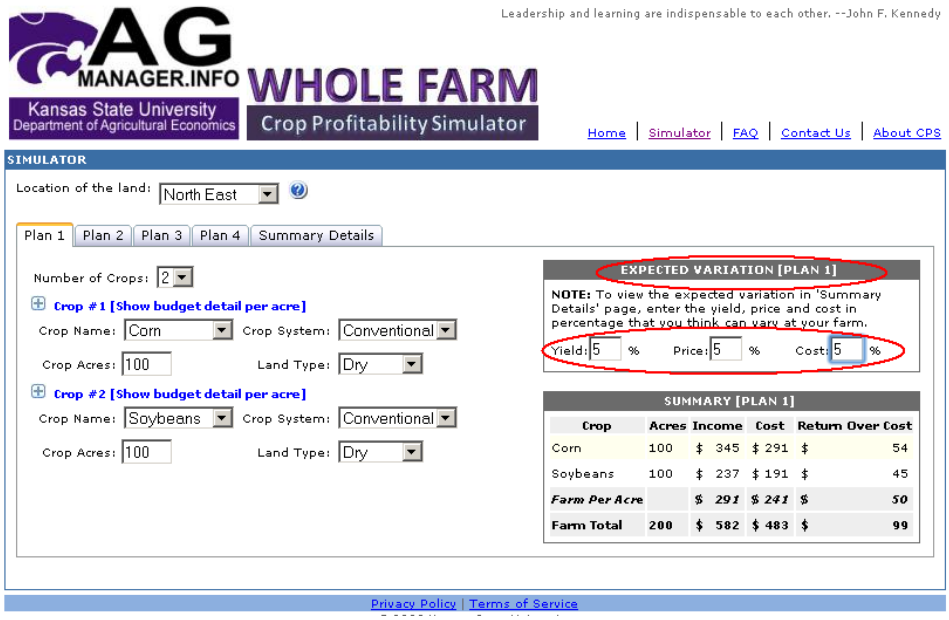
3.1.5.3 Expected Variation

For each plan, there will be an "Expected Variation" table where user can enter "Yield", "Cost" and "Price" that can vary at user's farm. The expected variation data helps to the best and worst estimate of profit along with the average.


Leadership and learning are indispensable to each other. --John F. Kennedy
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Crop Profitability Simulator
Home | Simulator | FAQ | Contact Us | About CPS
SIMULATOR
Location of the land: North East
Plan 1 | Plan 2 | Plan 3 | Plan 4 | Summary Details
Number of Crops: 2
Crop #1 [Show budget detail per acre]
Crop Name: Corn Crop System: Conventional
Crop Acres: 100 Land Type: Dry
Crop #2 [Show budget detail per acre]
Crop Name: Soybeans Crop System: Conventional
Crop Acres: 100 Land Type: Dry
EXPECTED VARIATION [PLAN 1]
NOTE: To view the expected variation in 'Summary Details' page, enter the yield, price and cost in percentage that you think can vary at your farm.
Yield: 5 % Price: 5 % Cost: 5 %
SUMMARY [PLAN 1]
Crop | Acres | Income | Cost | Return Over Cost
Corn | 100 | $ 345 | $ 291 | $ 54
Soybeans | 100 | $ 237 | $ 191 | $ 45
Farm Per Acre | | $ 291 | $ 241 | $ 50
Farm Total | 200 | $ 582 | $ 483 | $ 99
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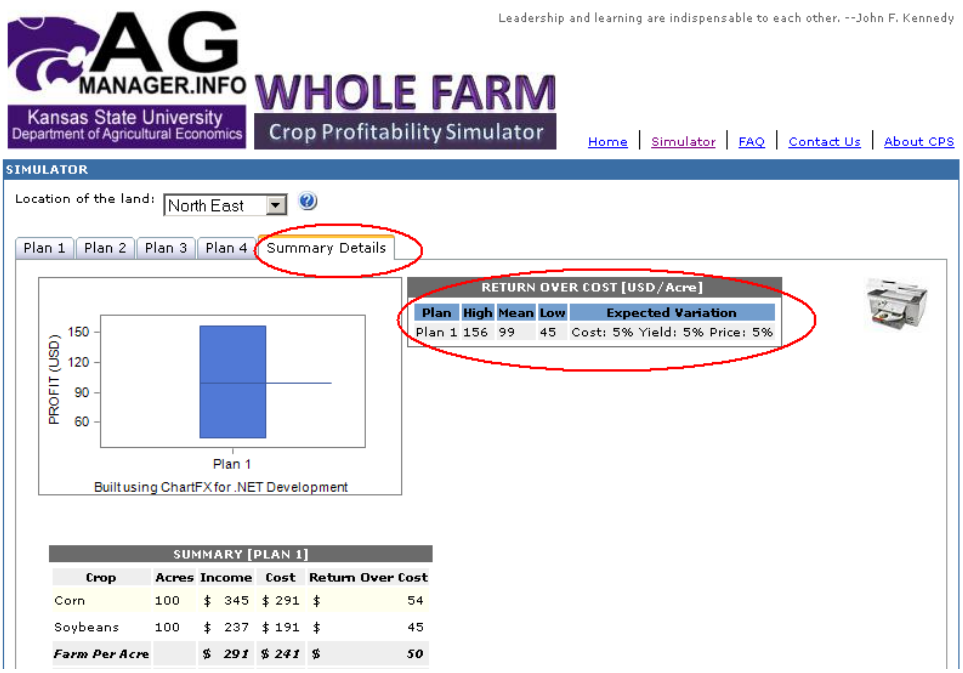
Leadership and learning are indispensable to each other. --John F. Kennedy
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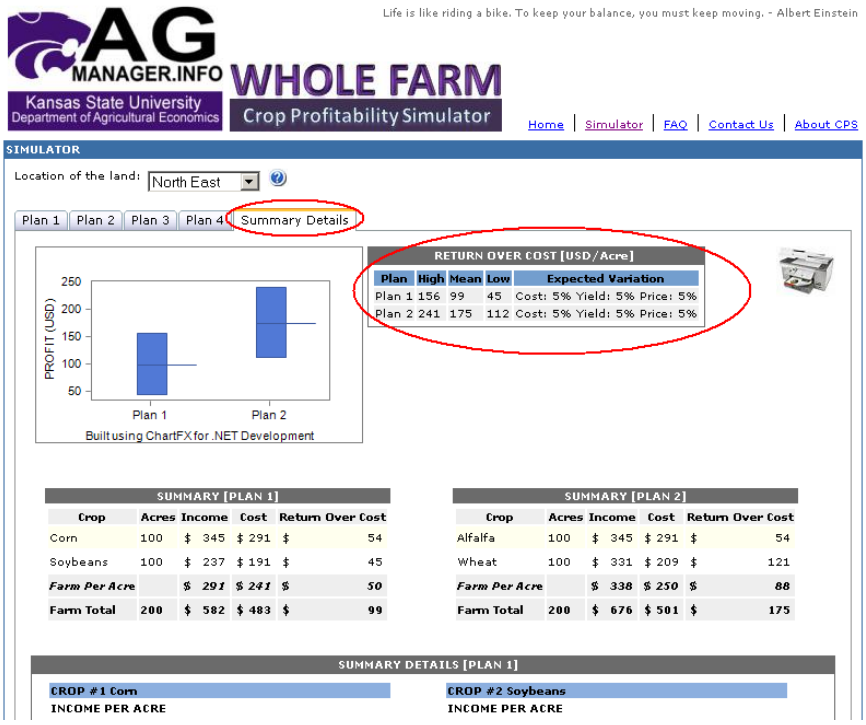
WHOLE FARM
Crop Profitability Simulator
Home | Simulator | FAQ | Contact Us | About CPS
SIMULATOR
Location of the land: North East
Plan 1 Plan 2 Plan 3 Plan 4 Summary Details
RETURN OVER COST [USD/Acre]
Plan High Mean Low Expected Variation
Plan 1 156 99 45 Cost: 5% Yield: 5% Price: 5%
PROFIT (USD)
150
120
90
60
Plan 1
Built using ChartFX for .NET Development
SUMMARY [PLAN 1]
Crop Acres Income Cost Return Over Cost
Corn 100 $ 345 $ 291 $ 54
Soybeans 100 $ 237 $ 191 $ 45
Farm Per Acre $ 291 $ 241 $ 50

3.1.5.4 Comparing Multiple Plans

Configure multiple plan and then click on 'Summary Details' tab. This will display comparison of plans you have configured side-by-side.


Life is like riding a bike. To keep your balance, you must keep moving. - Albert Einstein
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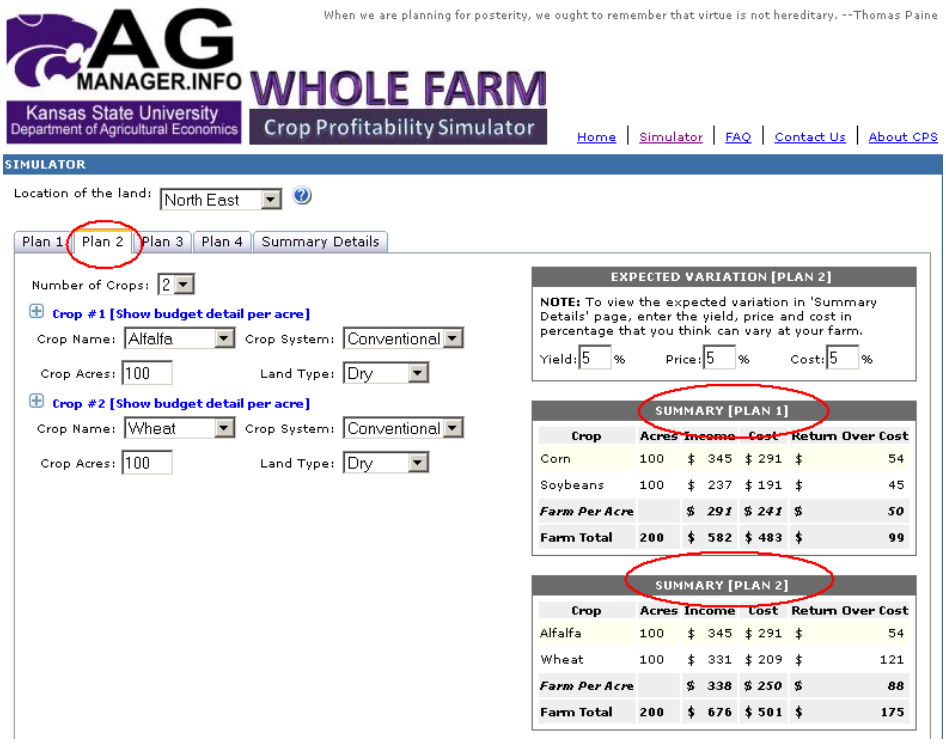
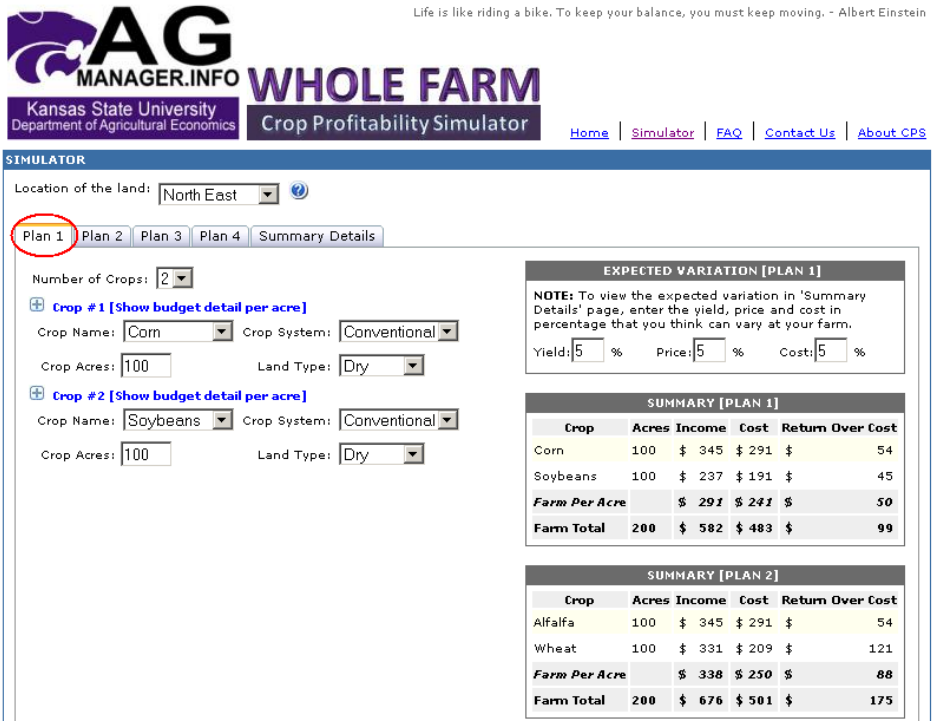
WHOLE FARM
Crop Profitability Simulator
Home | Simulator | FAQ | Contact Us | About CPS
SIMULATOR
Location of the land: North East
Plan 1 Plan 2 Plan 3 Plan 4 Summary Details
RETURN OVER COST [USD/Acre]
Plan High Mean Low Expected Variation
Plan 1 156 99 45 Cost: 5% Yield: 5% Price: 5%
Plan 2 241 175 112 Cost: 5% Yield: 5% Price: 5%
PROFIT (USD)
250
200
150
100
50
Plan 1
Plan 2
Built using ChartFX for .NET Development
SUMMARY [PLAN 1]
Crop Acres Income Cost Return Over Cost
Corn 100 $ 345 $ 291 $ 54
Soybeans 100 $ 237 $ 191 $ 45
Farm Per Acre $ 291 $ 241 $ 50
Farm Total 200 $ 582 $ 483 $ 99
SUMMARY [PLAN 2]
Crop Acres Income Cost Return Over Cost
Alfalfa 100 $ 345 $ 291 $ 54
Wheat 100 $ 331 $ 209 $ 121
Farm Per Acre $ 338 $ 250 $ 88
Farm Total 200 $ 676 $ 501 $ 175
SUMMARY DETAILS [PLAN 1]
CROP #1 Corn
INCOME PER ACRE
CROP #2 Soybeans
INCOME PER ACRE


When we are planning for posterity, we ought to remember that virtue is not hereditary. --Thomas Paine
AG MANAGER.INFO
Kansas State University
Department of Agricultural Economics
WHOLE FARM
Crop Profitability Simulator
Home | Simulator | FAQ | Contact Us | About CPS
SIMULATOR
Location of the land: North East
Plan 1 Plan 2 Plan 3 Plan 4 Summary Details
Number of Crops: 2
Crop #1 [Show budget detail per acre]
Crop Name: Alfalfa Crop System: Conventional
Crop Acres: 100 Land Type: Dry
Crop #2 [Show budget detail per acre]
Crop Name: Wheat Crop System: Conventional
Crop Acres: 100 Land Type: Dry
EXPECTED VARIATION [PLAN 2]
NOTE: To view the expected variation in 'Summary Details' page, enter the yield, price and cost in percentage that you think can vary at your farm.
Yield: 5 % Price: 5 % Cost: 5 %
SUMMARY [PLAN 1]
Crop Acres Income Cost Return Over Cost
Corn 100 $ 345 $ 291 $ 54
Soybeans 100 $ 237 $ 191 $ 45
Farm Per Acre $ 291 $ 241 $ 50
Farm Total 200 $ 582 $ 483 $ 99
SUMMARY [PLAN 2]
Crop Acres Income Cost Return Over Cost
Alfalfa 100 $ 345 $ 291 $ 54
Wheat 100 $ 331 $ 209 $ 121
Farm Per Acre $ 338 $ 250 $ 88
Farm Total 200 $ 676 $ 501 $ 175


Life is like riding a bike. To keep your balance, you must keep moving. - Albert Einstein
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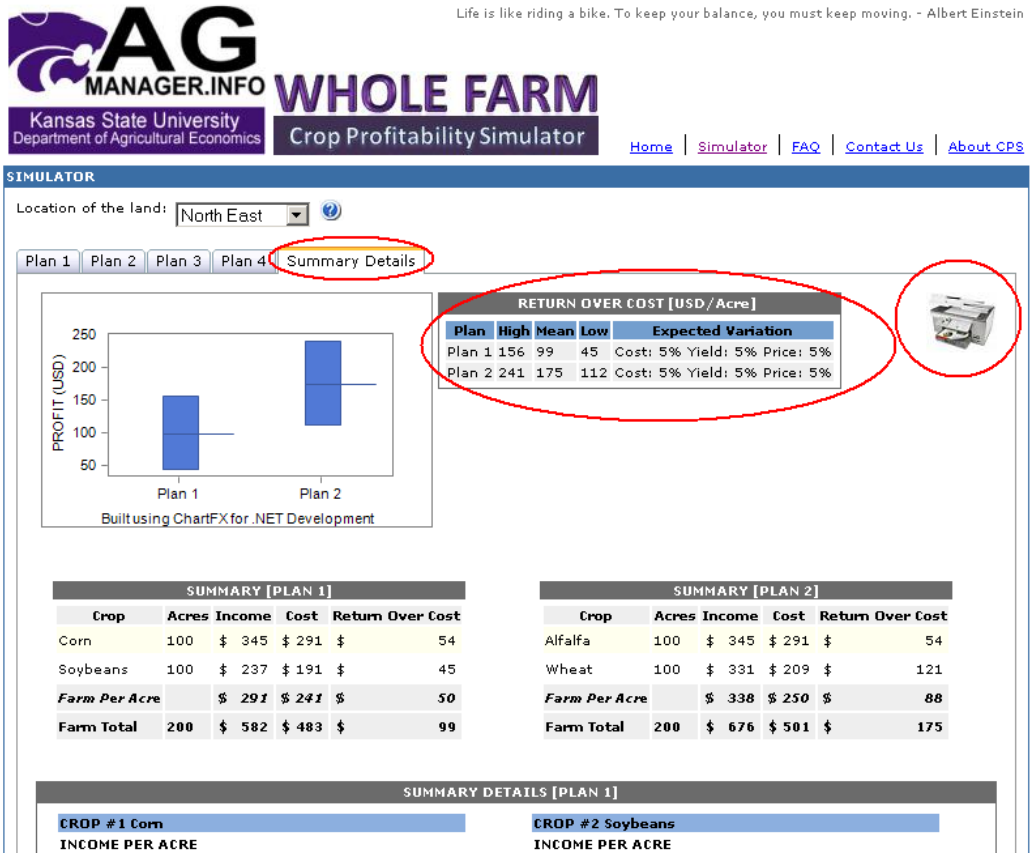
WHOLE FARM
Crop Profitability Simulator
Home | Simulator | FAQ | Contact Us | About CPS
SIMULATOR
Location of the land: North East
Plan 1 Plan 2 Plan 3 Plan 4 Summary Details
Number of Crops: 2
Crop #1 [Show budget detail per acre]
Crop Name: Corn Crop System: Conventional
Crop Acres: 100 Land Type: Dry
Crop #2 [Show budget detail per acre]
Crop Name: Soybeans Crop System: Conventional
Crop Acres: 100 Land Type: Dry
EXPECTED VARIATION [PLAN 1]
NOTE: To view the expected variation in 'Summary Details' page, enter the yield, price and cost in percentage that you think can vary at your farm.
Yield: 5 % Price: 5 % Cost: 5 %
SUMMARY [PLAN 1]
Crop Acres Income Cost Return Over Cost
Corn 100 $ 345 $ 291 $ 54
Soybeans 100 $ 237 $ 191 $ 45
Farm Per Acre $ 291 $ 241 $ 50
Farm Total 200 $ 582 $ 483 $ 99
SUMMARY [PLAN 2]
Crop Acres Income Cost Return Over Cost
Alfalfa 100 $ 345 $ 291 $ 54
Wheat 100 $ 331 $ 209 $ 121
Farm Per Acre $ 338 $ 250 $ 88
Farm Total 200 $ 676 $ 501 $ 175

3.1.5.5 Summary Details and Print

The summary along with its breakdown will be available for each plan in the "Summary Details" tab. The whole farm profitability (return over cost) for multiple plans will also be summarized in a graph for easy comparison with best/worst estimates when expected variation value is entered. User may print the detailed report by clicking on 'Print' icon.

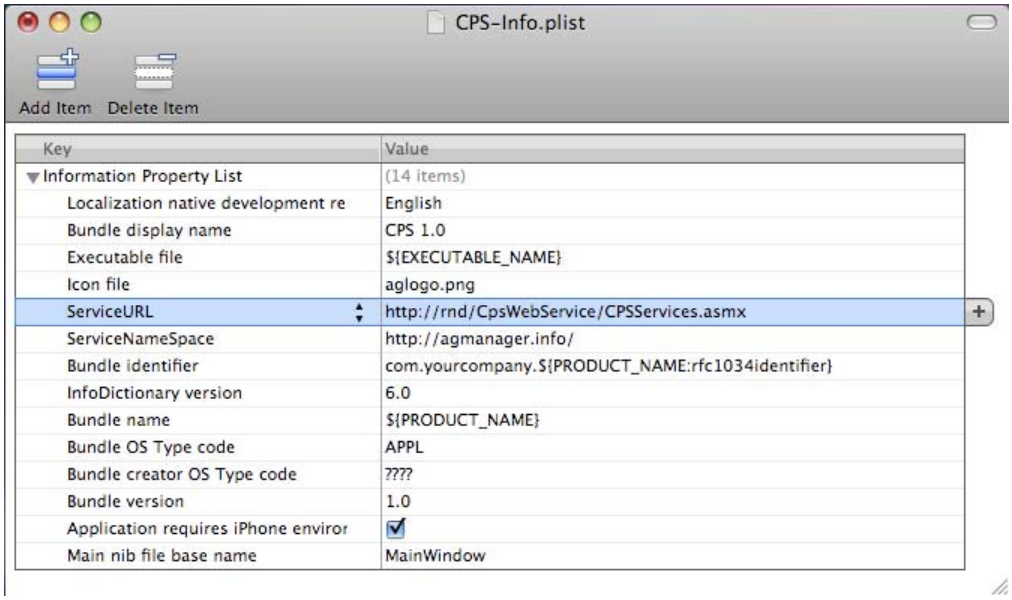

Life is like riding a bike. To keep your balance, you must keep moving. - Albert Einstein
AG MANAGER.INFO
Kansas State University
Department of Agricultural Economics
WHOLE FARM
Crop Profitability Simulator
Home | Simulator | FAQ | Contact Us | About CPS
SIMULATOR
Location of the land: North East
Plan 1 Plan 2 Plan 3 Plan 4 Summary Details
PROFIT (USD)
250
200
150
100
50
Plan 1
Plan 2
Built using ChartFX for .NET Development
RETURN OVER COST [USD/Acre]
Plan High Mean Low Expected Variation
Plan 1 156 99 45 Cost: 5% Yield: 5% Price: 5%
Plan 2 241 175 112 Cost: 5% Yield: 5% Price: 5%
SUMMARY [PLAN 1]
Crop Acres Income Cost Return Over Cost
Corn 100 $ 345 $ 291 $ 54
Soybeans 100 $ 237 $ 191 $ 45
Farm Per Acre $ 291 $ 241 $ 50
Farm Total 200 $ 582 $ 483 $ 99
SUMMARY [PLAN 2]
Crop Acres Income Cost Return Over Cost
Alfalfa 100 $ 345 $ 291 $ 54
Wheat 100 $ 331 $ 209 $ 121
Farm Per Acre $ 338 $ 250 $ 88
Farm Total 200 $ 676 $ 501 $ 175
SUMMARY DETAILS [PLAN 1]
CROP #1 Corn
INCOME PER ACRE
CROP #2 Soybeans
INCOME PER ACRE

3.2 CPS iPhone Application Operation

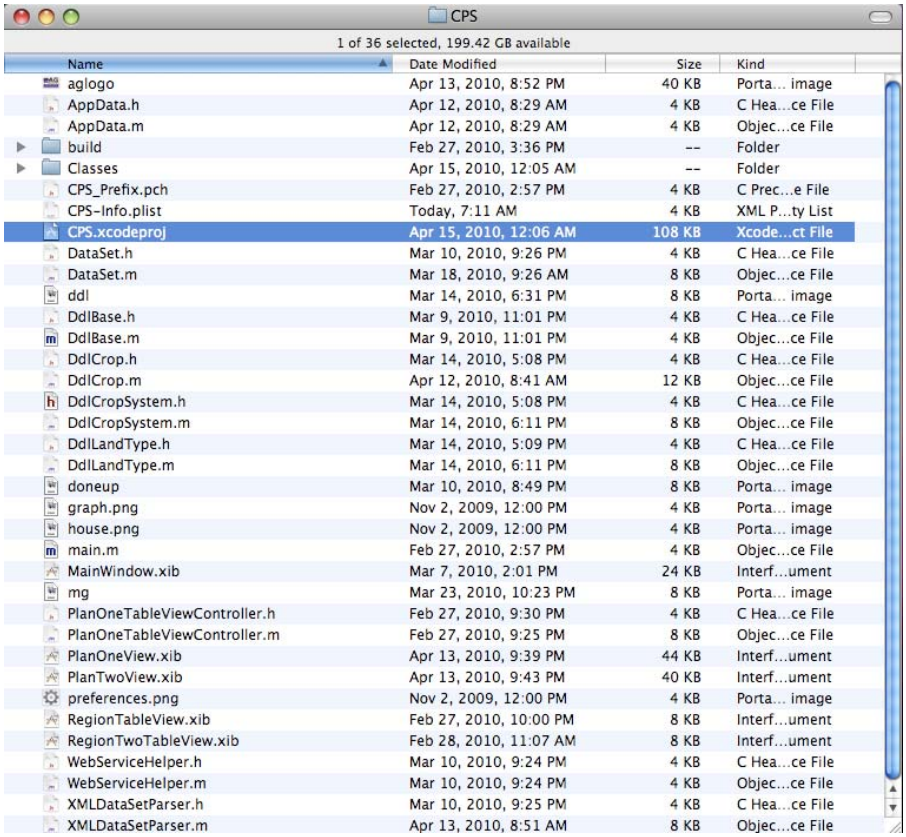
3.2.1 Simulator

Since the iPhone application is not packaged by Apple yet (which requires membership with Apple), the only way we can operate the iPhone application is via simulator built-in XCode, an IDE for iPhone development. To launch the CPS iPhone application, do the following:

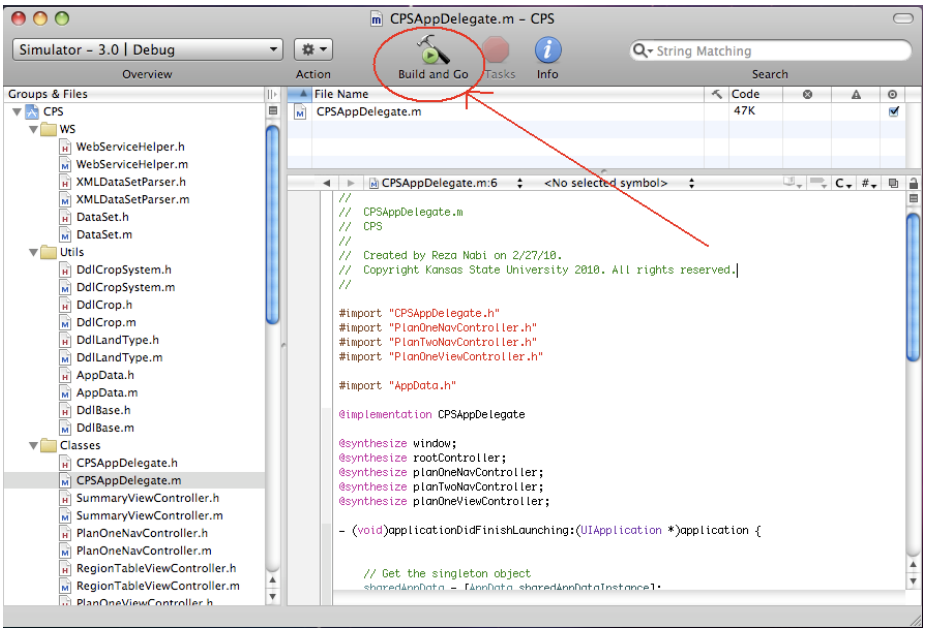
- Configure the Web Service URL for the iPhone Application. To do this, open CPS-Info.plist file and change the value of ServiceURL parameter that applies to your installation.



- Load the project by double clicking **CPS.codeproj** file



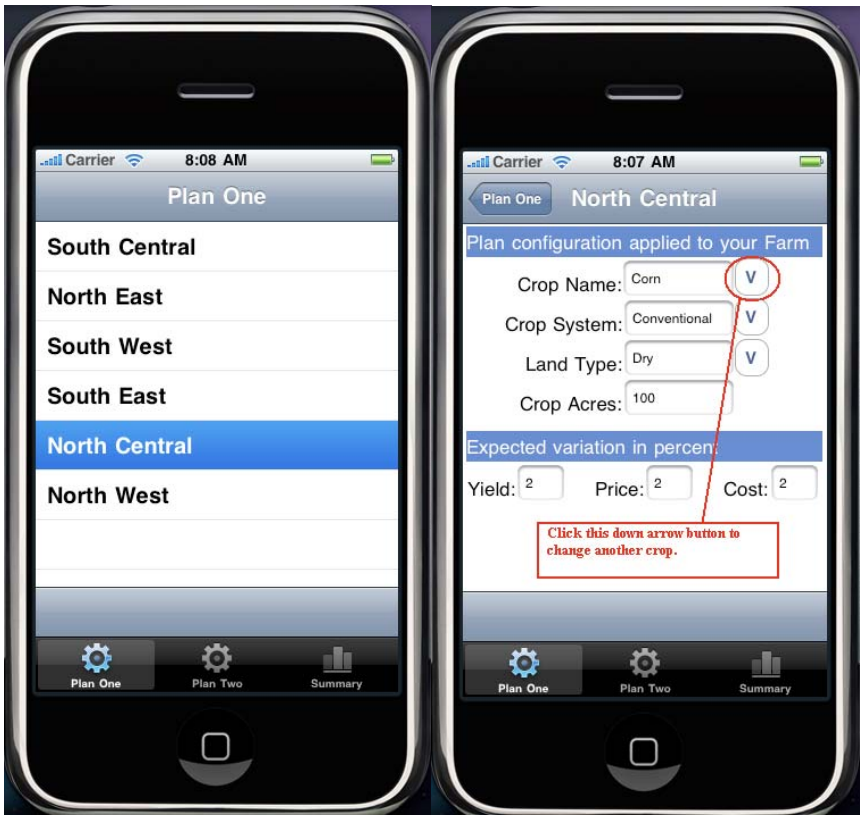
- Click on '**Build and Go**' icon.



3.2.1.1 Configure a Plan

Configuring a plan is a two step process.

- Select a region (e.g. North Central)

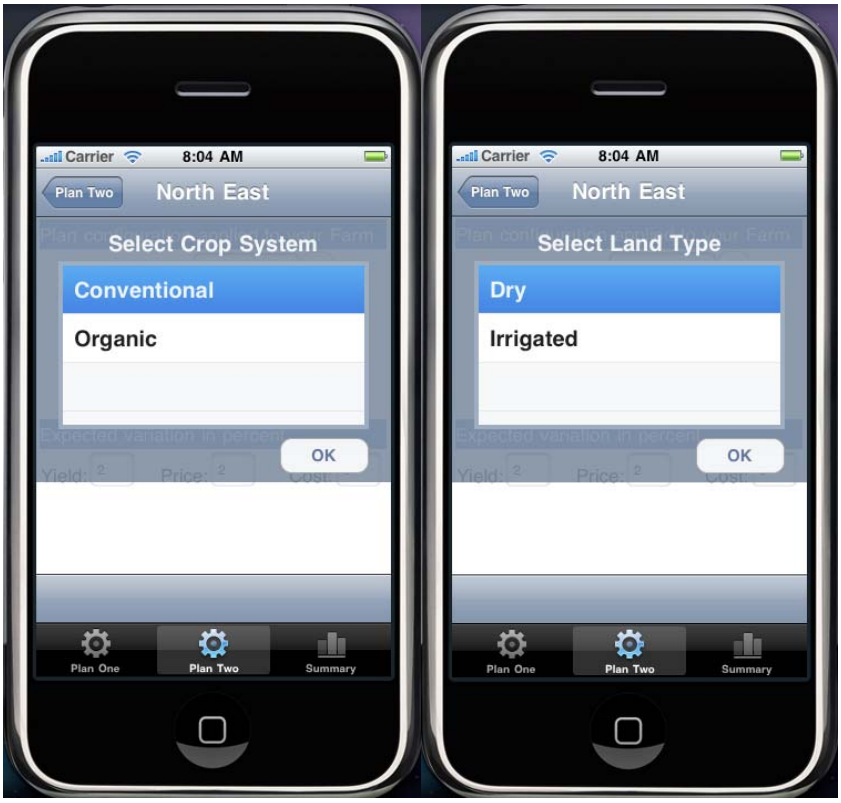


- For convenience all fields are populated except “Expected Variation”. Change the value of Crop, Land Type, Crop System and Crop Acre that apply to your farm.

3.2.1.2 Configure Crops, Crop System and Land Type

To change Crop, Crop System and Land Type, tap the down arrow button. This will invoke a selection list. Select the desired value and tap the ‘OK’ button. Below are few screenshots.

Carrier
8:01 AM
Plan One
North East
Plan configuration applied to your Farm
Crop Name: Corn
Crop System: Conventional
Land Type: Dry
Crop Acres: 100
Expected variation in percent
Yield:
Price:
Cost:
Click on these button to change values of those fields.
Plan One
Plan Two
Summary
Carrier
8:02 AM
Plan One
North East
Select a Crop
Soybeans
Corn
Wheat
OK
Plan One
Plan Two
Summary


Carrier
8:04 AM
Plan Two
North East
Select Crop System
Conventional
Organic
OK
Plan One
Plan Two
Summary
Carrier
8:04 AM
Plan Two
North East
Select Land Type
Dry
Irrigated
OK
Plan One
Plan Two
Summary

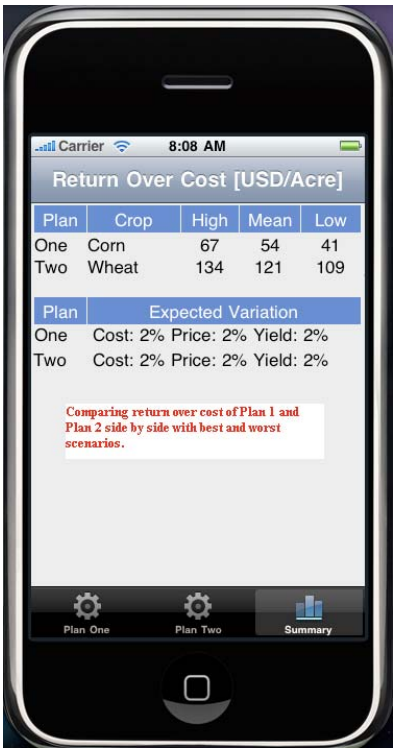
3.2.1.3 Expected Variation

For each plan, there will be an “Expected Variation” table where the user can enter “Yield”, “Cost” and “Price” that can vary at the user’s farm. The expected variation data helps estimate the best and worst of potential profit along with the average. To enter expected variation data, type a number and tap ‘Done’. Selecting ‘Done’ will cause the number pad to disappear.

3.2.1.4 Plan Comparison and Summary

To view a plan comparison side by side, configure both Plan 1 and Plan 2. Then select the ‘Summary’ tab. The system should display a “Return Over Cost” summary table, if an expected variation value is entered a the system will also display best and worst scenarios.

Carrier
8:07 AM
Plan Two
North Central
Plan configuration applied to your Farm
Crop Name: Wheat
Crop System: Conventional
Land Type: Dry
Crop Acres: 100
Expected variation in percent
Yield: 2
Price: 2
Cost: 2
Plan One
Plan Two
Summary
Carrier
8:07 AM
Plan One
North Central
Plan configuration applied to your Farm
Crop Name: Corn
Crop System: Conventional
Land Type: Dry
Crop Acres: 100
Expected variation in percent
Yield: 2
Price: 2
Cost: 2
Plan One
Plan Two
Summary


Carrier
8:08 AM
Return Over Cost [USD/Acre]
Plan Crop High Mean Low
One Corn 67 54 41
Two Wheat 134 121 109
Plan Expected Variation
One Cost: 2% Price: 2% Yield: 2%
Two Cost: 2% Price: 2% Yield: 2%
Comparing return over cost of Plan 1 and Plan 2 side by side with best and worst scenarios.
Plan One
Plan Two
Summary

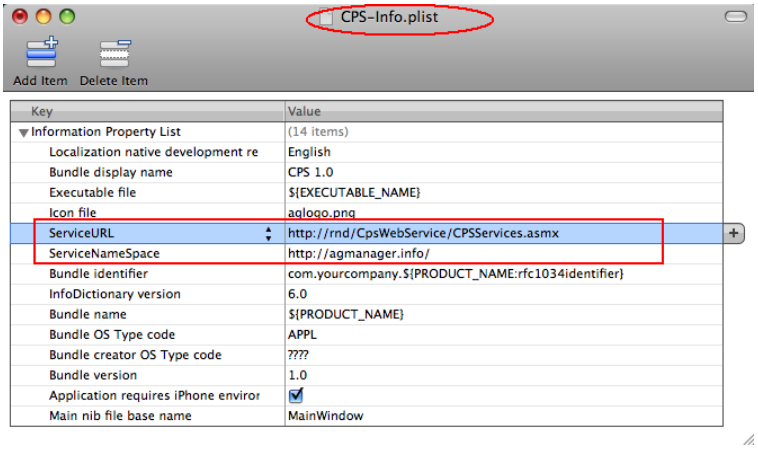
4 FAQ and Troubleshooting

This section provides information on frequently asked problems and how to troubleshoot the reported problem.

4.1 CPS iPhone Frequently Asked Question (FAQ)

4.1.1 When launching the iPhone application, I get service not available error. What should I do?

Answer: Open CPS-Info.plist file and make sure the ServiceURL and Service Namespace is configured correctly as per your installation.



4.1.2 When I click on ‘Summary’, I get Incomplete Plan. What should I do?

Answer: To display summary, system requires at least one plan to be configured. Please click on either Plan One or Plan Two, select a region, and enter all required values like Crop, Crop System, Land Type and Total Acre. Then, click on ‘Summary’ tab.

4.1.3 I have found a bug with the Application. What should I do?

Answer: Please contact either Dr. Andresen [dan@ksu.edu] or Dr. Hikaru [hpp@ksu.edu] or Reza Nabi [reza@ksu.edu]. We will address it in our next release.

4.1.4 I have an enhancement request. Who should I contact?

Answer: Please contact either Dr. Andresen [dan@ksu.edu] or Dr. Hikaru [hpp@ksu.edu] or Reza Nabi [reza@ksu.edu]. We will address it in our next release.

4.1.5 I am having problem Installing CPS iPhone application. What should I do?

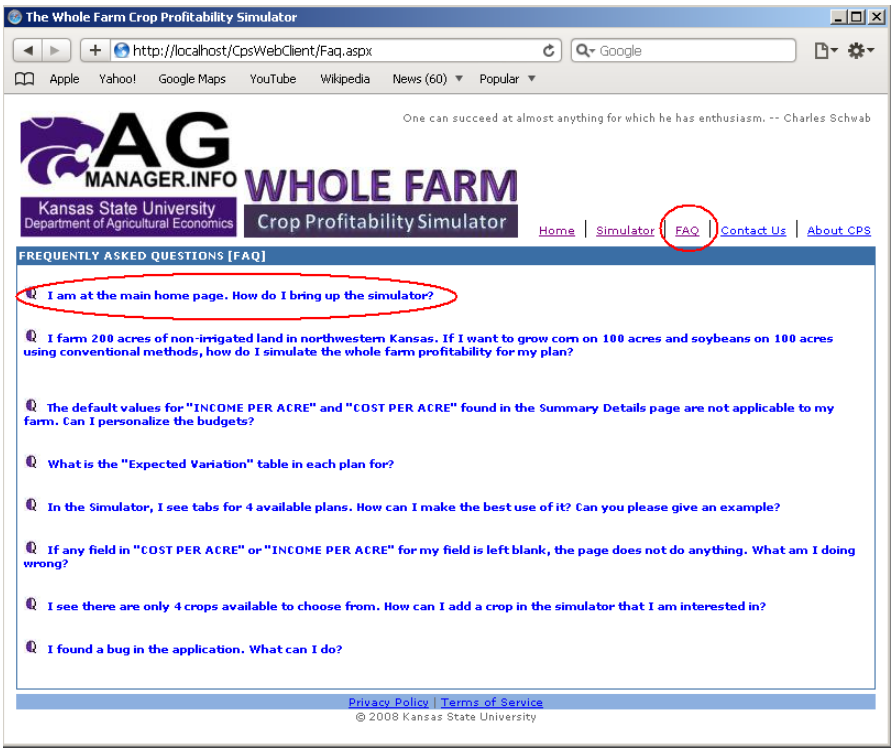
Answer: Please contact Reza Nabi [reza@ksu.edu]. We will help you to resolve the problem you are encountering.

4.1.6 I want to install this CPS iPhone application to real iPhone device. How can I do that?

Answer: As soon as we package CPS iPhone application via apple, you should be able to download and install the application to either iPhone or IPod touch from Apple store. We have plan to do this over the summer. Stay tuned!

4.2 CPS Web Application FAQ

A detailed version of the Fequently Asked Questions (FAQ) section is available for the Web application. To access the FAQ page, load the CPS web application and click on 'FAQ' link.


The Whole Farm Crop Profitability Simulator
http://localhost/CpsWebClient/Faq.aspx
Google
Apple
Yahoo!
Google Maps
YouTube
Wikipedia
News (60)
Popular
One can succeed at almost anything for which he has enthusiasm. -- Charles Schwab
AG MANAGER.INFO
Kansas State University
Department of Agricultural Economics
WHOLE FARM
Crop Profitability Simulator
Home | Simulator | FAQ | Contact Us | About CPS
FREQUENTLY ASKED QUESTIONS [FAQ]
I am at the main home page. How do I bring up the simulator?
I farm 200 acres of non-irrigated land in northwestern Kansas. If I want to grow corn on 100 acres and soybeans on 100 acres using conventional methods, how do I simulate the whole farm profitability for my plan?
The default values for "INCOME PER ACRE" and "COST PER ACRE" found in the Summary Details page are not applicable to my farm. Can I personalize the budgets?
What is the "Expected Variation" table in each plan for?
In the Simulator, I see tabs for 4 available plans. How can I make the best use of it? Can you please give an example?
If any field in "COST PER ACRE" or "INCOME PER ACRE" for my field is left blank, the page does not do anything. What am I doing wrong?
I see there are only 4 crops available to choose from. How can I add a crop in the simulator that I am interested in?
I found a bug in the application. What can I do?
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CHAPTER 10 - PROJECT EVALUATION

1 Introduction

This chapter presents the summary of experiences gained during the entire life cycle of the MSE project.

2 Problems Encountered

2.1 Learning Objective-C, Coacoa, XCode & the world of iPhone Development

I have never owned a Mac, and I have never used a Mac until this project. I had to start from scratch, learning the basic OS functionality through development of applications. In addition, I had to learn Objective-C. The language has different styles and flavor, nothing like Java or C#. I always enjoy learning new things and I enjoyed learning Objective-C as well.

2.2 Apple's UIViewPicker, an alternate solution of Combobox, Not Usable

To select an item from a list, Apple has a control called UIViewPicker. This is very bulky and not good looking at all. For CPS application, I had to come up with a custom control like ComboBox to save real-estate.

2.3 Hiccup to performance testing using WebService (SOAP) sampler

While executing my performance testing, I was able to run the load tests for web pages with no issues. However when I attempted performance test on accessing the web service only, it didn't work. After couple of hours of trial and error, found that there was a bug in the version I was using. After downloading the latest version from the Sun website it worked great.

2.4 USE Model and OCL

I learned USE and OCL in CIS771, Software Specification course. I had to brush-up on my USE and OCL skills.

3 Source Lines of Code (SLOC)

My initial estimate of source line of code in Phase II was 5500 LOC (Web: 2500 + iPhone: 2000). After finishing the project, I used the LocMeter tool to count SLOC. It turned out that my estimate was off. Section 3.1 and 3.2 provides the SLOC of Web app and iPhone app given by LocMeter Tool.

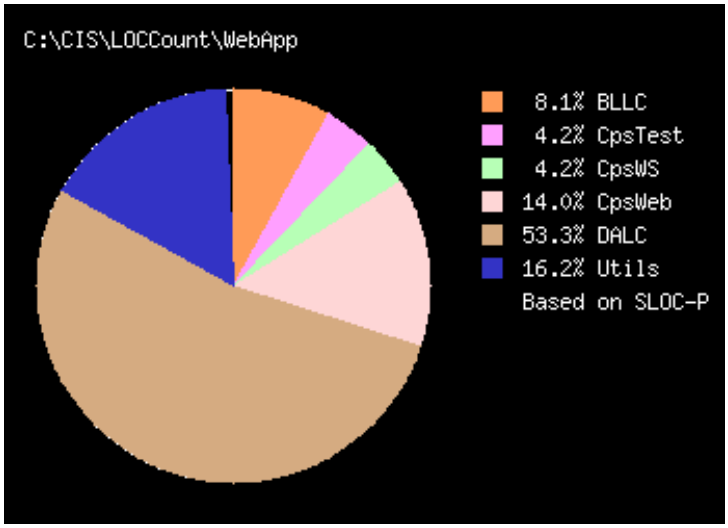
3.1 SLOC of CPS Web App

Total SOLC reported by LocMeter: **5185**

Table 10.3.1 SLOC of CPS Web app

C:\CIS\LOCCount\WebApp - Overall		
Symbol	**Count**	**Definition**
Source Files	44	Source Files
Directories	64	Directories
LOC	5184	Lines of Code
BLOC	818	Blank Lines of Code
SLOC-P	3006	Physical Executable Lines of Code
SLOC-L	1803	Logical Executable Lines of Code
MVG	167	McCabe VG Complexity
C&SLOC	12	Code and Comment Lines of Code
CLOC	1360	Comment Only Lines of Code
CWORD	5436	Commentary Words
HCLOC	0	Header Comment Lines of Code
HCWORD	10	Header Commentary Words

Figure 10.3.1 SLOC Distribution of CPS Web App



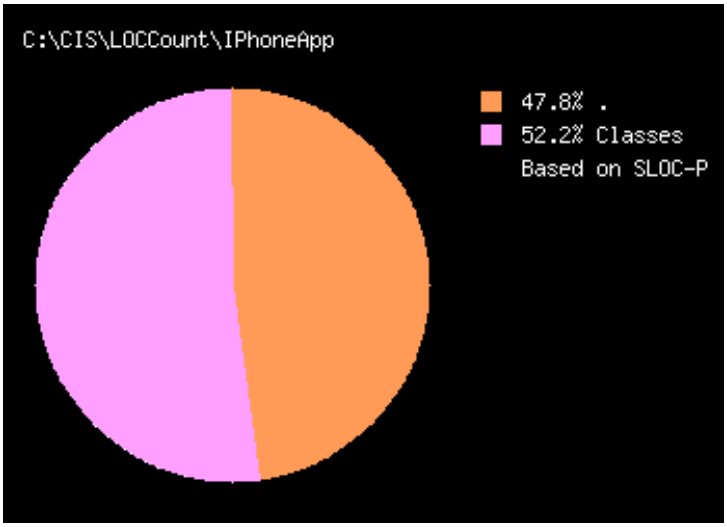
3.2 SLOC of CPS iPhone App

Total SOLC reported by LocMeter: **3678**

Table 10.3.2 SLOC of CPS iPhone App

C:\CIS\LOCCount\IPhoneApp - Overall		
Symbol	**Count**	**Definition**
Source Files	35	Source Files
Directories	17	Directories
LOC	3678	Lines of Code
BLOC	936	Blank Lines of Code
SLOC-P	1934	Physical Executable Lines of Code
SLOC-L	1410	Logical Executable Lines of Code
MVG	131	McCabe VG Complexity
C&SLOC	7	Code and Comment Lines of Code
CLOC	808	Comment Only Lines of Code
CWORD	3473	Commentary Words
HCLOC	245	Header Comment Lines of Code
HCWORD	560	Header Commentary Words

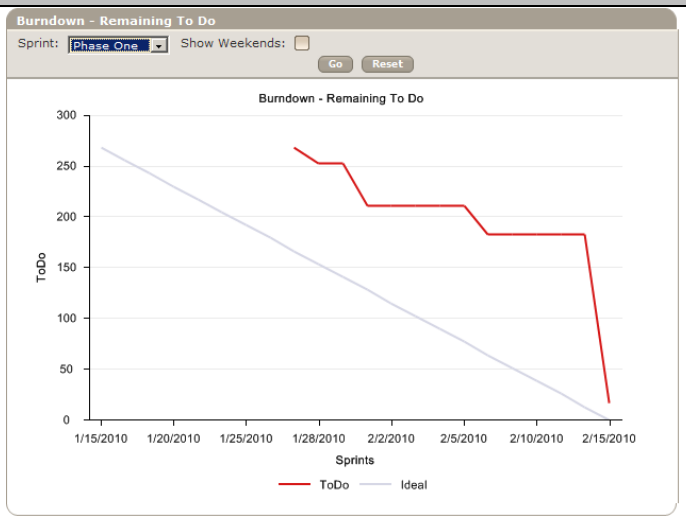
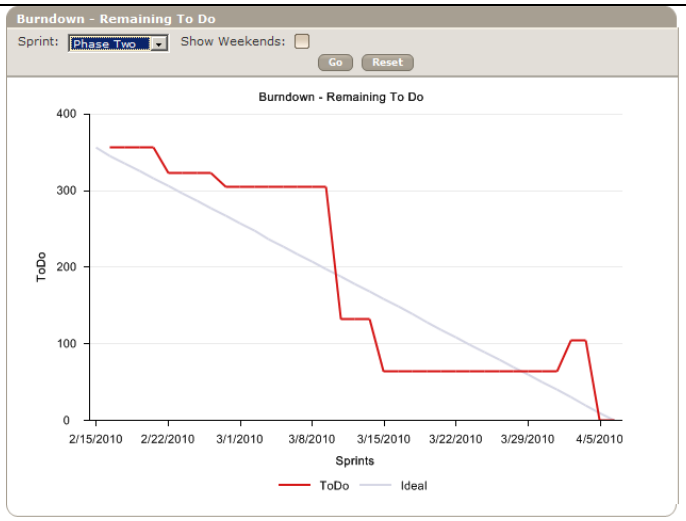
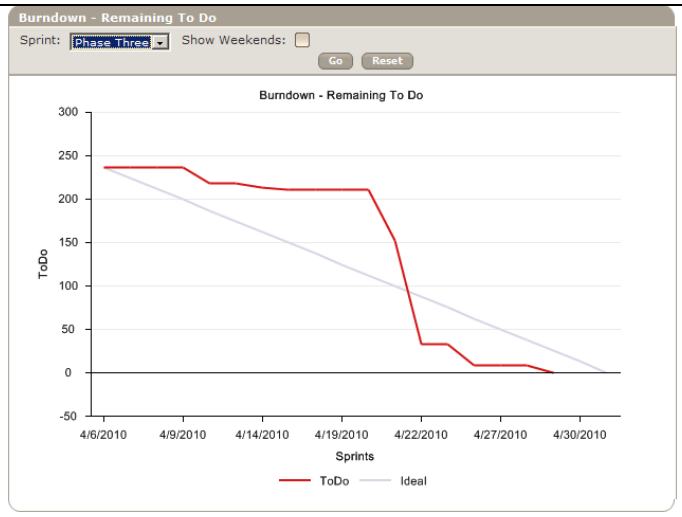
Figure 10.3.2 SLOC Distribution of CPS iPhone App



4 Project Duration & Burndown

This project was planned to finish by the end of the spring semester. The project proceeded smoothly, without any major hiccups. Below is the duration of the project along with the burndown chart which clearly shows that in Phase II and III, project was ahead of schedule.

Table 10.4.1 Project Duration and Burndown

Phase	Start Date	Finish Date	How well did it go? [Burndown Chart]
Phase I	01/15/2010	02/15/2010	
Phase II	2/16/2010	04/06/2010	
Phase III	04/07/2010	05/04/2010	

5 Lessons Learned

- Working and understanding USE, OCL and core UML notations used to draw architectural diagrams.
- Being that person responsible for everything, this project gave me great experience of playing every role required to develop and release software.
- Learned IEEE standard of various documents which were required to produce in each phase. I learned a lot while producing various deliverables using IEEE standards.
- This project gave me a chance to learn Service Oriented Architecture and implement a model solution ensuring the highest level of software reuse and Interoperability.
- From not knowing anything about the Mac operating system, this project gave me great opportunity to learn and develop a full-fledge application integrated with various platforms.
- This project also gave me a great knowledge and experience to integrate software between rival technologies like Microsoft and Apple.

6 Conclusion & Future Work

In this project, we developed fully functional CPS Software based on core Service Oriented Architecture. The CPS Software is deployable on multiple platforms and accessible via both web browser (universal client) and iPhone (or iPodTouch) reusing the same server components, as well as leveraging open standards like XML, SOAP, WSDL and UDDI. In this project, we proved that SOA is not a buzzword; it is real when it comes to achieving the highest level of interoperability, loosely coupled integration, modularity, and software reuse.

Future works of this project are comprised of two parts: first, get an Apple Developer Membership and package the iPhone client code so that it can be deployed on an actual iPhone device with ease; second, I would add more features to the iPhone client, allowing users to enter their custom data and view summary details.

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Appendix A - Formal Inspection Letter of Suresh Pothuri

April 24, 2010

Re: Formal Inspection letter for Reza Nabi's MSE Project

Dear Dr. Andresen:

I have reviewed Architecture document, USE model and tested the service CPS Software. All diagrams conform to core UML notations. In addition, verified that CPS Software meets all the functional requirements. All items provided in the formal checklist document are passed.

Sincerely,

Suresh Pothuri
Software Engineer
Sage Software
Email: suresh.pothuri@sage.com

Table 1-1 : Results of Formal Inspection Checklist

Item#	Inspection Item	Artifact	Results	Comments
TI.1	The symbols used in the class diagrams conform to UML standards.	Architectural Design Document 1.0	Pass	
TI.2	The symbols used in the sequence diagrams, state machine diagram, use case diagram conforms to UML standards.	Architectural Design Document 1.0	Pass	
TI.3	The symbols used in the component view diagram conforms to UML standards.	Architectural Design Document 1.0	Pass	
TI.4	The symbols used in deployment diagram conforms to UML standards.	Architectural Design Document 1.0	Pass	
TI.5	The USE model, associations, and invariants are sufficient to meet the requirement outlined in section 3.1 and section 3.2 in vision document.	USE Model - Formal Specification Document 1.0	Pass	
TI.6	The USE instantiation scripts and other cmd scripts provided with USE model is sufficient to verify the invariants (to holds / violates).	USE Model - Formal Specification Document 1.0	Pass	
TI.7	Test CPS Software and verify that it meets all functional requirements stated in section 3.1 and 3.2 in vision document.	CPS Software	Pass	

Appendix B - Formal Inspection Letter of Amit Borcar

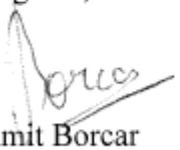
April 23, 2010

Re: Formal Inspection letter for Reza Nabi's MSE Project

Dear Dr. Andresen,

I have completed the Formal Technical Inspection for Reza Nabi's MSE project as per the checklist provided in "Formal Inspection Checklist Document 1.0". I found everything satisfactory. All items in the checklist passed.

Regards,



Amit Borcar
Software Engineer
Sage Software
Email: amit.borcar@sage.com

Table 1-1 : Results of Formal Inspection Checklist

Item#	Inspection Item	Artifact	Results	Comments
TI.1	The symbols used in the class diagrams conform to UML standards.	Architectural Design Document 1.0	Pass	
TI.2	The symbols used in the sequence diagrams, state machine diagram, use case diagram conforms to UML standards.	Architectural Design Document 1.0	Pass	
TI.3	The symbols used in the component view diagram conforms to UML standards.	Architectural Design Document 1.0	Pass	
TI.4	The symbols used in deployment diagram conforms to UML standards.	Architectural Design Document 1.0	Pass	
TI.5	The USE model, associations, and invariants are sufficient to meet the requirement outlined in section 3.1 and section 3.2 in vision document.	USE Model - Formal Specification Document 1.0	Pass	
TI.6	The USE instantiation scripts and other cmd scripts provided with USE model is sufficient to verify the invariants (to holds / violates).	USE Model - Formal Specification Document 1.0	Pass	
TI.7	Test CPS Software and verify that it meets all functional requirements stated in section 3.1 and 3.2 in vision document.	CPS Software	Pass	